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By  
**Nat Schachner**

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June, 1937

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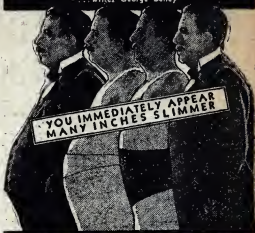
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# EARTHSPIN

*The principle was simple—the law  
of action and reaction.*

by Nat Schachner

ON AUGUST 16, 1955, the emperor of a certain small but heavily populated and even more heavily armed country delivered his ultimatum to a startled world. "We must," quoth he, "have room to expand. Our national boundaries have long since ceased to be sufficient; our land has been ravaged by alternate floods and droughts until it is no longer capable of supporting our people. Too long have we been confined and hemmed in by the jealous nations. We are virile; we are fertile; we do not intend to stand such envious discrimination any longer. We demand colonies in which to grow and breathe; we demand our place in the sun."

And, immediately, the saber rattled in its scabbard, the green-clad troops prepared for war; tanks lumbered into formation; great battle planes hid the sun with their numbers; grim, gaunt cruisers got up steam. Impending war hung like a thundercloud over all the earth.

The United States and other great nations called a hasty conference. Diplomats hid uneasy thoughts under long-practiced, inscrutable masks; foreign secretaries looked harried; chiefs of staffs planned campaigns, shook impatient heads and planned them over again.

There was a quick hush when the American secretary of state rose to have his say. All during the heated morning session he had kept silence, while the others wrangled and argued. Now

he was going to speak. Elliot Dodd was a man of few words.

"We must be realistic," he said quietly. "This is no time to discuss ethics, matters of abstract rights and wrongs. A situation confronts us; it must be met. The emperor has delivered an ultimatum. He is prepared to back it up with the only language he knows: force, war! What are we going to do about it?"

"Crush him!" interjected a gold-laced general. He made a significant gesture with two fat fingers. "Like that!"

Dodd let his calm eye drift over the tense assemblage. "Yes," he said, "I take it that we could do it. And perhaps that may be the only ultimate solution. But has the worthy general, the rest of you, counted the cost? The emperor has prepared long and secretly; most of us have simply drifted in the matter of armaments. His scientists are among the best in the world, and all their energies are devoted to his service.

"We could win—yes—but in the process millions of men will have died; famine and disease will have ravaged the world, and civilization have returned to the dark ages. Perhaps it might be wise to meet him halfway, to yield some of our surplus colonies to the settlement of his overabundant people."

Britain's foreign minister shook his head hastily. "Britain, for one, has none that it could possibly give up without grave consequences," he declared.

"Nor has France!"



*The visor-screen operator turned an ashen face, reached desperately for a plug to spread the warning. But—*

"Italy, my friends, has but too few as it is."

The quick disclaimers of other nations spread around the council table. It was an excellent plan, they all agreed, but not for themselves. *Their* colonies were sacrosanct, were special cases.

Dodd smiled wearily. He had not expected success. "It seems then," he began—and stopped. The door of the council chamber slid smoothly open. A startled attendant peered in, announced: "His excellency, Count William!"

MARK ALDEN jerked his head up with the others. His keen glance, veiled to hide his hammering thoughts, swept the gaudy resplendence of the intruder. Mark sat unobtrusively next to Elliot Dodd, his official position that of secretary to the American secretary of state. Actually, he was the eyes and ears of the American government, the delicate probe on which it relied to discover the skeleton facts that lay enswathed under the clouds of diplomatic verbiage.

"Had the emperor become impatient?" Mark wondered. "Had he sent his notorious minister of propaganda to throw down the gauge of battle to the assembled nations?" Outwardly, Mark relaxed in his chair, with sleepy-seeming languor, waited for the dynamite to explode.

But Count William had come with no dynamite. His bull neck was supple, his smile was ingratiating, his voice obviously tempered from its natural bel-low. "You have not come to a decision as yet?" he asked softly.

"We have not," Dodd retorted with some acerbity. "This unseemly haste is—"

The count spread his fat fingers placatingly. "The emperor," he said with smooth unction, "is anxious for peace with his neighbors. He has felt that you might have difficulties; he has therefore sent me to iron them out, to mod-

erate his just demands so that all may be friendly and neighborly again."

Mark tensed every faculty, though he seemed to lounge with careless indifference. What new devilry was the emperor up to now? A similar suspicion stirred uneasily through the others. They had witnessed his tactics too long to be taken in again by words.

"Come to the point," Dodd snapped.

William clicked his heels, bowed. His voice had never been so oily before. "The emperor realizes that there would be a natural reluctance on the part of your great nations to yield your inhabited colonies, with their populations and natural resources. He therefore proposes an alternative—one that he is certain you will be glad to meet."

The assembled delegates braced themselves for the blow. But when it came it left them gasping, bewildered with mingled incredulity and relief.

"He asks but the barren, uninhabited continent of Antarctica," the count declared surprisingly, "that sterile region of snow and ice where no human being has lived and where it has long been taken for granted that none could ever exist. He asks but that, and a modest additional area of fifty thousand square miles circumscribing the other pole, an even more barren and dismal territory. Surely these are but small exchanges for his just demands."

Even Dodd, the eternally calm, stammered a bit in answer. "But in Heaven's name, Count William, what does he wish with these dismal regions?"

William surveyed them with a queer glitter in his eyes. Only Mark, trained to pierce the very wrappings of the soul, noticed that glitter. "Our countrymen," he explained, "are a virile, hardy race. They are not afraid to brave icy blasts and inhospitable conditions. They require but room to expand, space in which to develop their innate genius. On the continent of Antarctica are almost 4,000,000 square miles."



Sensation reigned. Had the emperor gone mad? Well, if he had, so much the better. Those nations which held vague claims to the frozen wastes were content—nay, eager—to yield their pretensions, and thus avoid a world war in which the victors would be equally ruined with the vanquished. The ethereal waves, the cables, burned with code messages to the home governments. Swift consents burned their way back again.

The documents were formally signed; to the emperor was given formal title to all the continent of Antarctica, to the tiny area of the north pole, involving but a sea of ice and some glacier-covered islands, besides the northernmost tip of Greenland. The diplomats rubbed their hands in glee. They had done an excellent piece of work, they felt. The emperor had gone suddenly mad and they had taken advantage of his condition. They held a great banquet; they toasted Count William and his absent emperor.

William accepted their protestations at face value—or so it seemed—and departed for his native country, the useless document carefully sealed in his portfolio.

BUT ONE MAN could not get rid of a sense of strange unease. As the fast cruiser swept over the turbulent Atlantic, bearing the American mission home, Dodd rallied his young companion. "Why the long face and cloudy looks, Mark?" he demanded. "We've saved the world from a disastrous war and given the emperor a barren empire. Surely, *that* is cause enough for rejoicing."

"I'm not so certain we would not have done better to defy the emperor and have the war," Mark answered slowly.

The secretary of state looked at him quickly. It was obvious that Mark Alden was not joking. "What do you

mean?" he exclaimed. Long and intimate acquaintance with his young friend had given him a wholesome respect for the processes of his mind, the lightning-like intuitions of his brain.

"Hasn't it struck you as queer," Mark evaded, "that he asked for a few frozen miles at the north pole, as well as the vast area around the southern antipodes? Granted that his countrymen can render habitable the vastnesses of Antarctica, why his manifest desire for the paltry waste at the opposite end of the earth?"

Dodd was startled. "Why—why ——" he stammered, and could go no further. In the tremendous anxiety to seal the bargain, no one of the assembled diplomats had thought of that angle. Yet now that it was mentioned, it *was* strange. Then he laughed. "It's the general consensus of opinion that he has gone crazy," he declared.

But Mark, remembering that queer gleam of triumph in William's eyes when the last document was signed, was not so sure of it. Yet, since he had nothing definite to go on, he said no more. The matter dropped.

## II.

SIX MONTHS PASSED. The world relaxed; the troops were demobilized; the great battle planes stood moodily in their hangars. Civilization went about its proper business; the pursuit of happiness, of private wealth, of love. The emperor no longer rattled the scabbard; he was strangely meek and complacent. Mark Alden watched with wary eyes, but could see nothing wrong. In the evenings, he discussed the puzzling situation with his closest friend, but they could arrive at no solution.

This friend was Fred Kingsley, already, at thirty, the only scientist in the world to cope on an even basis with Dr. Paul Crusard, of the emperor's realm. He was a great geologist, a

physicist of note, a delver into the puzzling realm of electromagnetic phenomena.

The two friends were wholly dissimilar in characteristics, and therefore all the closer bound to each other: Mark Akden was tall, inscrutable, his slight slouch concealing steel-strung muscles and tremendous strength, his veiled, sleepy eyes covering a razor-edged brain. He was the most valuable man in the secret service, but not even Fred Kingsley knew that his best friend was anything else but what he appeared, officially, to be.

Kingsley, on the other hand, was the complete scientist. Of medium height, energetic, absorbed in his studies, content to take the rest of the world at its face value, he tried to laugh away Mark's hinted fears.

"It is possible, of course," he decided, "to make Antarctica semiinhabitable. I know that Crusard has long been studying the terrain. He found some volcanic areas, whose heat might be tapped. There are doubtless veins of coal, strata of iron, under the eternal ice. But it would cost fabulous sums to colonize even to a degree, and the colonists would always live on the ragged edge of disaster. As for the North Polar Region, that is wholly incapable of sustaining the smallest colony."

Yet, to the vast astonishment of a skeptical world, the emperor proceeded with his plans. Great transports steamed toward the frozen seas, convoyed by formidable battleships. Surprised observers reported that they were laden to the brim with colonists—thousands of them; that freighters were packed high with cargoes of food, of lumber, of steel girders, with huge boxes that obviously held immense pieces of machinery.

They sailed in secrecy, and the piers bristled with guards. Planes hovered by night and by day over the steadily

steaming flotilla, as if to cover them from even aerial observation. Yet Mark received reports. He studied them, frowned.

The colonists were men exclusively, and Dr. Paul Crusard had sailed with them. Mark wrinkled his brows, saw Dodd confidentially. Was the colonization but a mask for a surprise attack on the American coast? This was something that Elliot Dodd could envisage. Quiet orders issued. The American fleet sailed for maneuvers in coastal waters; the coast defenses were reinforced.

But the emperor's vast array surged ever south, far out on the Atlantic, steamed past South America, past Cape Horn, into the regions of eternal mist and drifting icebergs, into Ross Sea, and heaved anchor on the very verge of the ice wall that marked the boundary of the frozen continent.

Then the long night swallowed them up.

Another convoy followed, and another. The world rocked and buzzed. The emperor was going through with his insane plans. And to the north, a smaller fleet set sail. It headed toward Iceland, forced its tortuous way through ice-clogged passages into the Arctic Ocean, made landing in a fiord of northern Greenland, just within the granted territory. Then that, too, was heard from no more.

THE WORLD buzzed, and mocked. The emperor, obviously quite mad, had embarked thousands of his best men, had scattered his war fleet to the veritable ends of the earth. He was no longer to be feared. Elliot Dodd thought so, too, and Fred Kingsley as well. But Mark began to wear a harried look. He could not fathom it quite, but he was under no illusions. The emperor was not mad. He was playing a deep game.

Then, early one morning, Mark Akden ushered a bluff, weather-beaten whaling captain into the presence of

Elliot Dodd. At least, that was what the man seemed, with his sailor's jacket and jaunty cap, his thick boots and grizzled hair.

"This," he introduced, "is Earl Wesley, one of my cleverest operatives. Tell Mr. Dodd your story."

Wesley spoke with clipped words. "It's nothing much. Pursuant to Mr. Alden's instructions, I took a plane to Buenos Aires and chartered a ship for a whaling cruise. I had no difficulty in picking up a crew; the port's full of sailors on their uppers. It was all very legitimate. Then we sailed south, around Cape Horn, whaling. We even caught two big fellows, cut them up, tried out and barreled the oil.

"Then we coasted the continental barrier, sailing toward the west. I kept a sharp lookout. Several times we narrowly missed the emperor's patrolling warships. Twice I heard the roar of overhead planes. But they didn't see us in the ice fog. Then we entered Ross Sea. We hid by day in ice-clogged channels, slipped along by night. I was following your instructions, Mr. Alden, to the letter.

"On the last day I started out before dawn. As the sun glinted over the towering ice pack, I steamed boldly into Little America, where Byrd had made his base years ago. I carried the Argentinian flag at my mast."

He hesitated, and something in the man's air snapped Dodd to keen attention. "Well?" he demanded. "What next?"

"I wouldn't have believed it," replied the operative slowly, "if I hadn't seen it with my own eyes. There, cut out of the ice wall, was a real city—with piers and great warehouses and unloading cranes and ships at anchor. New York Harbor itself couldn't have been busier. Fur-clad men heaved and shouted as they took off cargoes. Half a mile inland, there was an airport, cut smooth as a ballroom floor in the solid

ice. Even while I watched through my telescope, I saw great cargo planes take off, head inland over the wild ranges, others come roaring in to land."

He grunted, scowled apologetically. "That was all I had a chance to see. Half a dozen destroyers came scooting from anchor at the sight of me. They hove me to with a shot that almost took away my bowsprit. They meant business, those babies. And they laid down a smoke screen that completely cut off any further view of the port."

"Go on," Mark urged as Wesley stopped again.

Wesley grinned painfully. "I thought sure I was a goner. For they were mad—and I mean mad! It was touch and go whether they shot my whole crew out of hand. 'We were spies,' they told me, 'and they had a very efficient method for handling spies.' I played dumb; my crew didn't have to play at it. I was a Swenska seadog, I told them. Luckily, I could speak the language. I had been blown off my course; my compass had been broken—I did that just before they boarded me—and I didn't even know where I was. Then I showed them my barrels of oil, the smelly remains of the last whale.

"It was a toss-up. A kid captain of one of the destroyers took pity finally, decided the issue. Two warships escorted me all the way to Tierra del Fuego, with hideous threats as to what would happen if I ever again poked my nose into Antarctic waters."

Mark turned somberly to Dodd. "That's the story, Elliot. And I had another operative try as a sealer through Baffin Bay in the north toward Etah. He never got there. Just out of Canadian waters a pocket cruiser chased him back with a couple of very businesslike shells. And they weren't blanks, either. Now what do you think of the set-up?"

For a moment a shadow flitted over the official's face. Then he smiled. "Nothing at all, Mark," he retorted.

"Those are just examples of the emperor's pleasant little ways. He never did like to be snooped on. I can see no reason for alarm."

### III.

BUT MARK ALDEN could, and did. And, being a man of energy, he decided to do something about it—unofficially, of course. He asked for an indefinite leave of absence.

Dodd looked at him queerly. "Don't try anything foolish," he warned with sudden anxiety. He thought very highly of Mark. But Mark avowed very gravely that he intended nothing foolish—after all, the word had controversial meanings—that it was simply a vacation he was taking. So that perforce, albeit reluctantly, Dodd granted the request.

Mark's next steps were swift and decisive. He held a lengthy conference with his friend, Fred Kingsley. He hated to do this, but he wasn't sufficient of a scientist for what lay ahead. Kingsley was essential, even though the chances of coming back alive were exceedingly slim. But Kingsley, after the first skeptical explosion, fell in with a readiness that caused Mark considerable qualms of conscience. Mark was used to desperate emprise and the air of danger; but the soft-lapped, unwarlike scientist—

They set out from Washington, secretly, at dawn, in a trimotored, high-speed pursuit plane, with a guaranteed flying radius of ten thousand miles. In the cockpit was a miscellaneous cargo: certain delicate scientific instruments, a heavy cache of food, warm furs for subarctic temperatures, skis for ice traveling, rifles, automatics—and a number of atomite bombs, each of which could have pulverized the Empire State Building to impalpable dust.

They flew south. "The real heart of the mystery lies in Antarctica," Mark

decided. "The North Pole Station is the subsidiary one." And Fred, thinking of Dr. Paul Crusard, agreed.

They reached Rio de Janeiro without adventure. Once, from the ten-thousand-foot level, they saw far beneath, on the broad flanks of the Atlantic, a convoy steaming slowly south—more men, more equipment, sent by the emperor to his mysterious Antarctic colony.

At Rio they refueled, again sped southward along the coast. A landing at Buenos Aires, then on to Gallegos, port of last resort at the tip of savage Patagonia.

Here they aroused some unwanted curiosity, but they were just two American adventurers, with pseudonymous passports, who hinted of prospecting for gold on Tierra del Fuego. The mixed population of the frontier outpost shrugged collective shoulders, sold them gasoline at outrageous prices, and went back to their foggy existence.

Then south again, this time at fifteen thousand feet altitude, with a muffler on the propeller, to dampen the roar. It was essential that the emperor's scout boats should not know of their presence near the prohibited territory.

Huge icebergs drifted like ghostly toys far beneath; fog and snow and screaming gales took them in the bit and tossed them a hundred miles off course; bleak, skeleton islands appeared in dazzling sunshine and disappeared in driving snow. Then, straight ahead, like a knife edge cutting the gray, turbulent sea, Antarctica reared itself—a huge wall of winding ice, tossing itself ever southward in tier on tier of frozen mountain ranges.

Mark was piloting. Fred Kingsley knew nothing of planes. They wore their furs now, and the cabin was electrically heated. Outside, the temperature was fifty below, on the Fahrenheit scale. It was a glorious sight, that contorted upthrust of fathomless ice, gleam-



ing with mysterious fires, under the slanting rays of the broad, red sun. But to Mark, crouched over his controls, the wild beauty held a sinister mystery. The feeling had grown on him, had become an obsession, that the fate of the world was being forged within the fastnesses of the ice continent; that on his—and Kingsley's—shoulders rested the intolerable burden of averting that fate.

HIS PLAN of campaign, up to a certain point, was mapped. He did not head for Ross Sea. Instead, he cut over the ridged Graham Islands, swung high along Wendell Sea, and zoomed across Hearst Land and the grim mountain range that made a jumbled escarpment of the interior. He intended coming around on the emperor's base in Little America by the back door. After that— He shrugged his shoulders. They would have to trust to his nimbleness of resource and Fred's scientific knowledge.

He made a wide detour. No human eye had even seen this part of the interior. They lunged over unmapped mountain ranges, whose saw-tooth pinnacles meant instant death if their motors stalled for a moment; they leaped over fathomless gorges whose depths penetrated the hard, iron skeleton of the continent; they tossed and groaned in every strut at sudden blasts of icy air. Fred watched at the telescope.

In all that wide waste there was no sign of human being or human handiwork. So far they were safe. The low sun skirted the horizon. An eerie twilight fell on the land.

"How far are we inland?" Mark queried.

Fred Kingsley made hasty calculations. "About two hundred miles," he reported.

"Safe enough from casual planes," Mark decided. "We'll level off due west. Ross Sea is about eight hundred

miles from here; we can make it in less than three hours."

Obediently, the plane swung to the stick. The sky was ablaze now—a shimmering, frozen dance of color and torment.

Fred sucked his breath sharply. "The southern lights!" he exclaimed. "The *aurora australis*, counterpart of the *aurora borealis*. I've never seen them so magnificent."

But Mark had no eye for their wild beauty. His eyes narrowed with thought; his mouth was grim and hard. "Tell me, Fred," he cut across his companion's admiration with brutal abruptness, "hasn't the aurora something to do with sun spots?"

Kingsley looked surprised. "There is a connection," he admitted, "though the exact tie-up is still vague. All we know is that the sun spots are vast pools of electrical disturbance, that the auroras are also electrical phenomena, and that they ebb and flow together in an approximate cycle of eleven years."

Mark seemed to have difficulty with his utterance. "And when is the next period of maximum disturbance?" he asked.

Fred thought a moment, then vented an exclamation. "Why, it's just about now! End of spring, summer of 1956. I remember, too, there were predictions that the sun-spot area would be of unprecedented proportions this cycle. No wonder the aurora is so blinding. But why do you ask?"

Mark bent over his controls, said nothing. Slowly, a startling thought was shaping in his mind—

AN HOUR LATER, Kingsley exclaimed again. His eye had been constantly glued to the telescope, was sweeping the frozen wastes beneath.

"Look! Over there!"

They peered through the dancing, steel-hard colors. A plane was winging far to the west, pointing south, directly

toward the pole. Seconds later the roar of its unmuffled propeller throbbed faintly in their ears. Then the glinting rainbow tints swallowed it up.

Mark's brow went black as a thundercloud. He ground out an oath, swung his stick hard. Like a willing race horse, the plane caromed sharply, fled southwest in pursuit of the stranger.

"For Heaven's sake, Mark," Kingsley yelled, "are you mad? That way is the pole—and destruction. Our way is Ross Sea, just in back of Little America. Heaven knows we've discussed what we were going to do often enough."

"Plans are changed," Mark said through his teeth. "We're following that plane."

"Where to?"

"To the south pole!"

He vouchsafed no further information, and Fred Kingsley asked for none. He had learned to trust implicitly in the swiftness of Mark's intuitions. For several hours they followed the invisible trail. The southern lights faded into a dull, drab twilight that shaded the unknown continent in mysterious gloom. They flew high and with the muffler dampened. But the trail resounded in their delicate amplifiers, and they held to it like a bloodhound on the scent. Their quarry had no reason to cut the roar of its propellers, to sense the pursuit.

A frozen moon swung in a narrow arc, flooded a landscape as strange as that of its own lifeless surface. Once they caught another sound in their amplifiers—another plane heading north—heading toward Ross Sea from the south pole! They skimmed perilously close to a fantastic mountain range to avoid being seen, looked at each other with bloodless faces.

Then, suddenly, in the waning light of the moon, from an altitude of twelve thousand feet, within the ramparts of ice-barbed mountains, an incredible scene burst upon the startled pair. So

suddenly that Mark, in his astonishment, almost lost control of the plane.

Far ahead a plateau loomed. Its surface was dark and bare. Around it, in an enringing circle, stretched the interminable white of crevassed ice. But the gaunt uplift of land, naked, for the first time in all history, to the revealing moon, was a festoon of twinkling lights. Lights that were stationary and lights that darted to and fro with exceeding swiftness.

The desolation seemed to swarm with life and activity. Through their powerful glasses they could pick out a veritable city of beehive huts, of larger buildings. The faint clank of machinery vibrated through the amplifiers. Red flames blasted into the night, died down again. The air shook with sullen roars, as of subterranean blasting.

"They've done it," Kingsley's voice was cracked with excitement. "I did not believe it possible. They've blasted off the ice and snow and reached hard ground. They've discovered the coal and iron veins that Scott and Byrd reported, have built smelters and furnaces. They are recreating a civilization—industrially as advanced as Pittsburgh or Essen—at the very apex of the world. This is Crusard's doing."

But Mark was not listening. His face was pale and grim. "Quick," he rasped, "sight your instruments and get me the exact location of that plateau. Every second's delay is dangerous. If they should discover us—"

Kingsley worked with feverish haste. Then he lifted his head, and there was a strange look in his eyes.

"That colony," he answered slowly, "is at Longitude O, Latitude 90. It has been constructed directly at the south pole!"

#### IV.

MARK made a precarious landing between two scowling hummocks of ice about ten miles from the polar colony.

He had jockeyed for half an hour trying to find just such a spot, off the direct line to Ross Sea, and well-hidden from observation. So skillful was he that the uneven, steel-hard snow crumpled their landing gear only slightly. No other damage. The plane could take off again if need be. And they had not been seen!

They worked now with feverish rapidity. All was again according to plan. Great furs lapped their bodies against the intense cold; huge parkas almost covered their faces. Their beards had already grown to an unshaved stubble. Mark roared with laughter when he looked at Kingsley; the scientist grinned back at him. Not even their closest friends could have penetrated the disguise. They were, by all outward appearances, subjects of the emperor.

They hauled the plane into a little gully, powdered it over with snow so that it would not be visible from above, strapped on skis, secreted in their voluminous furs a small supply of food—and automatics. The rest, perforce, must be left behind, including the deadly cargo of bombs. If, after their spying, they could win back to the plane with the knowledge they had achieved—

They clasped hands a moment, then strode clumsily over the rugged terrain without another word.

It was difficult, tedious work struggling over the fissured ice and snow. Octane thermometers strapped to their furs recorded sixty-two below zero. Their breath froze into powdered icicles as it left their lips. It was too cold even to speak. But they forged steadily ahead, toward the mysterious city which had been located directly at the pole.

No one saw them approach over the desolate wastes; no one suspected that human beings were plodding through the semitwilight. The noise and clank of heavy machinery, the bustle of ceaseless industry, grew louder as they neared. Directly ahead, the ice-free

plateau reared itself above the savage, encircling wilderness, ablaze with argon lamps which turned night into busy day.

Mark stumbled, disappeared with a strangled cry. One moment he had been fifty feet from the rim which had marked the dividing line between earth and ice; the next, the prehistoric glacier beneath his feet had seemed to vanish in a blast of rushing, particle-filled wind, and he had fallen into nothingness.

THERE WAS a crash, a roaring sound. His thrashing body collided with solid ground; his teeth rattled like castanets; his bones groaned with the terrific impact.

He sat up with a little moan, to see Kingsley sprawled at his side, lifting his head with an expression of stunned surprise.

"What—what happened?" the scientist gasped.

The fog cleared from Mark's brain. He stared, gulped unbelievably. They lay on uncovered earth—earth that had been hidden by an eternal blanket since the world began—earth frozen to steel-hardness, yet which, even as they heaved themselves unsteadily erect, was already softening into the dry, fertile loam of a Kansas prairie.

They were bruised and badly shaken, but otherwise unhurt. The thick furs had padded the twenty-foot drop. But Mark was worse shaken in his mind. For, in back of them, the way they had come on painful skis, there was already two hundred feet of similarly uncovered ground. And, even as they watched, wondering if they were mad, the area was increasing. Something invisible was biting huge, remorseless chunks out of the wall of snow and ice, swirling it through a haze of dancing particles into nothingness, and passing on with gigantic strides.

For a dazed thirty seconds they stood, staring. In that short space of time

Antarctica had ebbed away from them to a distance of half a mile. Something trickled down Mark's face. Mechanically, he brushed at it with fur-mittened hand. The trickle became a flood. It was perspiration! In even greater bewilderment he glared at the octane recorder on his wrist. The colored fluid was surging upward, reaching an incredible figure. It read sixty-four degrees above zero; whereas only a minute before it had hung lifeless at sixty-two below.

Kingsley was already shedding his heavy furs with feverish haste. Mark hastened to follow suit. He was stifling. In seconds the swathing garments made dripping huddles on the bare earth, and the two men, stripped to the drab, gray working clothes of the emperor's subjects, which they had worn underneath, mopped perspiring brows. Already a new landscape enveloped them as far as they could see—a terrain of brown, luxuriant soil. Far to the rear a saw-toothed mountain range still raised its ice-glistening pinnacles in defiant majesty.

Amazement, comprehension, struggled on Kingsley's face. "This is Crusard's doing." His voice was a cracked whisper. "He has harnessed incredible forces, put them to work. He has——"

Mark Alden's hand darted out, pulled the scientist violently into a little gully. "Down, if you value your life!" he said harshly.

They flung themselves to the ground just in time. From the direction of the polar city monstrous machines were lumbering straight toward them with thundering sound—gigantic tanks, lurching along on caterpillar treads. From their forward poops huge, funnellike structures swung back and forth in wide arcs. From the openings a blue radiance crackled and streamed, paled to invisibility a hundred yards in front. A fleet of giants, radiating from the mysterious

city like spokes of a wheel, advancing with great strides over the territory newly wrested from the long dominion of the polar blasts, hurtling on to newer and mightier conquests.

The two men flattened themselves in their scanty hiding place, barely breathed as the tanks moved on. One of the metal monsters passed them by, a scant few yards away, its blue swath slicing bare inches from their unprotected bodies. Then it was past them, vanishing with diminishing roar on its triumphant march to the distant boundaries of Antarctica.

THE SHADOW of remembered death was in their eyes as they arose. But the shadow gave way to a scientific glare in Kingsley's countenance. His voice was rapt, almost devout with awe. "Those were high-tension electromagnetic fields," he said. "I've never seen their like before. They must have a potential of at least a hundred million volts. They've created such tremendous fields of force that the molecules of ice and snow upon which they were trained became polarized into innumerable tiny, north-and-south-pointing magnets. The molecular adhesions which held them bound together were violently disrupted, and the solid ice sublimated at once into gaseous, molecular ice. The liquid water stage was eliminated entirely.

"With machines like that, Crusard will be able to clear the whole vast continent of Antarctica of its overlaid ice pack within days, and without the fear of overwhelming floods of water. It's stupendous! But where did he get the power?"

Mark said softly, though his face was bleak, "I think I know the answer to that one. But don't ask me now. Wait!"

Far to the north, in the direction in which the funnel-swinging tanks had disappeared, came a dull, booming sound. Through the eerie twilight, their startled eyes saw a descending rain of

burning, smoking embers. Then there was silence again over the wastes.

"Good Heavens, what was that?" Kingsley stammered.

"That," replied Mark even more softly than before, "was our plane. The electromagnetic beams exploded our atomite bombs. I think one of the tanks went up with it."

They stared at each other. All their plans had been as suddenly blasted as their plane. They were two solitary men, stranded on the vast Antarctic continent, alone in the heart of a mysterious, alien territory, without means of retreat, without possibility of escape, yielded up to the tender mercies of the emperor's men. They had nothing more than their clothes, small packets of food, and puny automatics. Before them, around them, for thousands of miles, stretched danger, mystery, and a ruthless enemy armed with new and incredible weapons.

Kingsley shivered a bit. It was getting cold again. The temperature was dropping steadily. Without a word he picked up his discarded furs, donned them carefully, meticulously. Mark did the same, watching his companion with a grim, yet affectionate smile. He had made no mistake in picking Fred Kingsley as his companion on this desperate adventure. The easy-going scientist was pure steel beneath.

"What do we do now?" Kingsley asked.

"Do?" echoed Mark. "We go to the city."

"Forward, then."

The twilight deepened into night as they plodded on—the night of the pole, six long, weary months of unrelieved darkness, of bitter blasts. But already the aurora australis had unfurled its banners again. The sky, the earth, even the great humming city that loomed ahead, were rivers of dancing fires, of sheeted colors that ebbed and flowed and crackled with supernal splendors. They

had never seen such an aurora before. It was appalling in its magnificent glory. Kingsley wrinkled his forehead. He was beginning to put two and two together. But he said nothing, and Mark, glowing in the radiant bath as in a witches' brew, was blank of all expression.

THEY PROCEEDED warily as the city neared. It reared itself on a long, sloping elevation to a height of some hundred feet. The tanks had disappeared on their mighty errand. They could see figures moving about, silhouetted against the argon beams, iridescent with the flicker of the southern lights.

The figures were dressed as themselves, in great, shapeless furs, surmounted by peaked parkas. It was again sixty below; within hours it would fall to seventy and even eighty. Mark had been as meticulous in his choice of garments as in his disguise.

Straight ahead, a gang was marching, clumsy in furs, obedient to the barked orders of their leader. A shift, either on the way to work, or retiring to their bunks. The two men crouched behind a little ridge, waiting for them to pass. The light was confusing, playing fantastic tricks on the eyes. But this was an unexpected break for the intruders.

As the column swung along, over the already rehardened ground, Mark whispered quickly, "Now's our chance!"

They arose quietly, slipped even more quietly in the rear, unobtrusively melted into the last straggling ranks. All the men's heads were bent, shielding faces against the bitter air, while the hoar frost of their breaths made white smoke around. So that no one saw them join, or thought anything amiss in these two figures, clad like themselves.

No one spoke; the cold was a physical impact on the opened mouth. Only the leader grunted brief commands through half-closed lips. They swung sharply, plodded toward the very center



of the city, toward a curious domelike mound of gray, light-quenching substance.

"Asbestos," Mark decided. "The perfect insulator against heat and cold." His eyes moved warily about, trying to comprehend the fantastic scene. All about were similar mounds, though of lesser size. Within them, no doubt, and burrowing underground, the colonists lived, guarded against polar blasts, and heated by understandable scientific means. A city of gigantic beehives!

There were others, too, larger in size, from which the dull vibration of machinery emanated. But none approached, in tremendous area, the central dome. And none had flanking it the two tall towers of dissimilar shape that guarded that great central dome. Mark cast stealthy glances at them. They were awe-inspiring, incredible in their structure.

The one on the left was of shining metal, some two hundred feet in height. It mushroomed out at the top into a complex grid of heavy steel, crisscrossing bars, from each of which sprouted a veritable forest of horizontal, cup-shaped rotors, spinning on tall, ball-bearing stalks of steel. There seemed no machinery to make them spin, no wind to shift their massive weights; yet round and round they went at incredible speed.

"There," grunted Kingsley suddenly, "is the answer—the source of the tremendous electromagnetic fields. Crusard has tapped the hurtling energy of the solar disturbances, of which the southern lights are themselves but a manifestation." Then he frowned. "But why directly at the south pole?" he queried himself. "Surely Crusard knew what every schoolboy knows—that his field-tapping rotors would have absorbed even more power at the magnetic pole, the true focus of the sun's streams of free electrons.

"And," he kept on whispering to his companion as they trudged steadily

along, "even granting the freeing of Antarctica from snow and ice, he could not possibly affect the temperatures permanently, even with all the power in the world, so as to render the continent inhabitable."

The strain on Mark's face deepened. "Crusard is no fool," he answered quietly. "The very objections you raise, and of which there is no doubt he is well aware, point to a deeper and more sinister meaning in the choice of the geographical south pole as against the magnetic. Fred, this is no mere colonization scheme; this is a plot that involves incredible consequences to the world."

"But how?" Kingsley asked, still bewildered.

Mark did not answer directly. He lifted his eyes to the second tower. "What do you make of that other structure?" he demanded.

It was a tall steel shaft, almost five hundred feet in height, some fifty feet in diameter, its exterior smooth and blank. But at the very top a horizontal shaft of similar diameter was laid across, for all the world like a right-angled T square. Its length was about one hundred feet in all. Kingsley shook his head. "I don't know," he confessed. "It might be anything; it all depends on what it houses in its interior."

"Looks to me like a handlebar," Mark muttered, "a grip for some supergiant."

"No talking, you men," shouted the leader suddenly. "Save your breath for your work. You'll need it."

The two Americans bent their heads lower, moved on in silence. Fortunately, they spoke the emperor's language with native facility.

THE CENTRAL DOME loomed gigantic before them. A door swung wide; they tramped through, and it closed instantly behind them. The interior was a complex of mighty machinery. Overhead was a web of trans-

mission cables, thick as a man's body. Dynamos, tall as buildings, hummed with energy.

The curving walls were paneled tubes, lambent with racing blue flames, sizzling with electric bolts of incredible voltage. Sluicing from these were storage batteries of novel design, huger than any even Kingsley had ever seen. Great bar magnets, coiled around with fine steel wires, swung overhead on frictionless pivots, weaved a swift, yet ordered dance in relation to each other, to achieve maximum power. Every instrument, every engine, that man had yet invented, and many that Crusard and his associates had devised in the strict secrecy of the emperor's laboratories, were compact in the vast interior.

But mightier than all else, twin machines that dwarfed even the fifty-foot dynamos, were the two shining balls that poised on groaning gimbals in the very center of the dome—two metal globes, shimmering with an iridescence that bespoke ceaseless, incredible power within, each one hundred and fifty feet in diameter.

Kingsley almost betrayed himself with his sudden start, his stifled exclamation. His nearest neighbor turned suspiciously, his dark face malign. Mark pressed close to his friend, dug him surreptitiously in the ribs, bent to unlace his fur boots. They were all doing that. It was warm inside, and the men were rapidly divesting themselves of polar garments, arranging them neatly on labeled hooks.

The scientist recovered himself, bent swiftly also. But thoughts buzzed round and round in his head. Those were electrostatic machines, of a size and capacity that made mere toys of the famous De Graaf affairs in America. His brain spun as he tried to calculate the total power of the pair; it seemed impossible to fill them all with sufficient energy. Yet obviously, from the lambent sparkling on their surfaces, from his

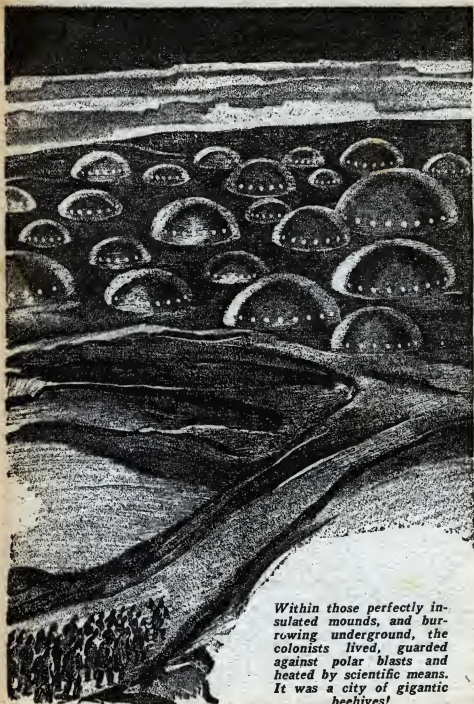
quick glance at the recording dials, they were close to saturation. The great cables that snaked around the interior, plunging through orifices downward into the bowels of the earth, lifting outward through the heavy asbestos walls, gave him an inkling as to the sources of that mighty store of energy.

He had seen the outside rotors, the ingenious devices for tapping the shimmering dance of the aurora, the flow of electromagnetism that emanated from the sun itself. But what came up from the depths of the earth? Could it be — Of course! He saw it all now. Crusard, in that earlier survey of the polar regions, years before, had incautiously avowed to the scientific world that he had found subterranean volcanoes on the continent. The earth's own magnetism, the mighty sun's electron streams, the surge of boiling lava—here was power beyond all human conceptions.

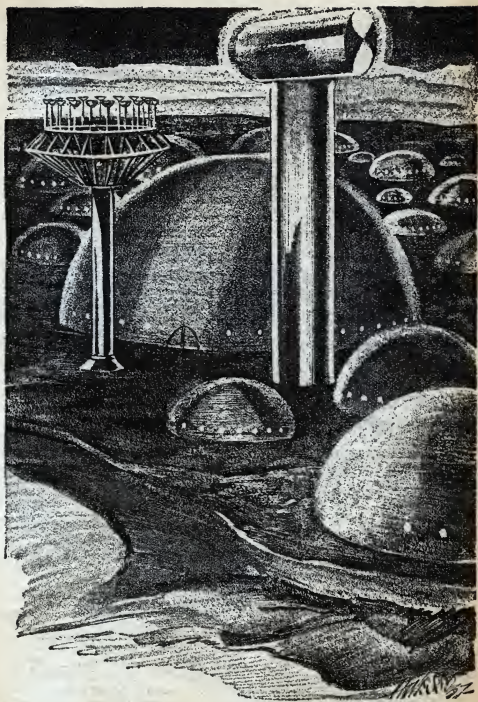
To what purpose? Still the frozen blasts would render the continent valueless for human habitation. And why not at the magnetic pole, the logical site? Why the colony at the limited north pole? Why the second tower with its horizontal crossbar that Mark had likened to a handle for some giant? Why? Why? Why?

Questions that Mark had said must be answered to save the earth from a doom beyond all imagining. The questions rolled and reverberated in Kingsley's mind, and found no answer. As in a dream, he took off his furs, followed mechanical suit with the others, hung them on the nearest hook.

A BURLY FIGURE, furs limp on brawny arm, rumbled a guttural oath at him. "Dumbhead!" he snarled. "That's my hook. Take your filthy stuff off you—" His eyes narrowed. "Say!" he roared, so loudly that the group stopped their undressing, brought the



*Within those perfectly insulated mounds, and burrowing underground, the colonists lived, guarded against polar blasts and heated by scientific means. It was a city of gigantic beehives!*



leader up on the run. "Who are you? You ain't in our shift?"

Mark stiffened, edged surreptitiously away.

A panic swept over Kingsley. He had betrayed himself. And Mark Alden, his friend, the man who had brought him into this peril, was obviously abandoning him. Then he steadied. Mark was right. More than mere friendship depended on this. The fate of the world was involved. If Mark, in the resulting confusion, could hide—

He essayed indignation, mumbled the guttural tongue to spluttering incoherence. "Stupid ass!" he hissed. "Of course I'm not; my leader told me to report to this shift. Shut your big mouth!"

But the sergeant was already upon him, exploding in a torrent of questions.

"Here, you, what's all the row about?"

The burly one said, submissively, "This here fellow tried to take my hook. He ain't from our shift."

The sergeant was short and pompous. He turned on Kingsley. "Who are you? What's your name?"

"Frederick Storm."

"Your former shift?"

Blindly, the scientist plunged. "No. 10."

"Your sergeant's name?"

Kingsley fumbled with the button of his packet. He was caught, trapped. If he could only get to the automatic in the inside pocket in time. Mark Alden had vanished quietly into the wilderness of machines.

"Hurry up," snapped the sergeant.

"I don't remember."

"Oh, you don't, eh?" Like a flash, a heavy revolver was covering the American. "Grab him, men. We'll find out fast enough who he is."

Despair settled on the scientist. They sprang upon him with a will; rough

hands pawed over his clothes. The automatic came out, the packet of food.

"So!" said the sergeant malignantly. He examined the weapon. It was of American workmanship. "So!" he repeated with a certain vicious satisfaction. "A spy, ha! Dr. Crusard will be most interested."

"IN WHAT, pray, will I be interested?" a cold voice asked.

The men fell away, groveled. The sergeant, a moment before so pompous, authoritative, deflated like a pricked balloon. Dr. Paul Crusard was the emperor's right arm, his visible representative in Antarctica. "We just caught a spy, excellency," the sergeant stammered.

"So!" remarked Crusard, turning critical glance on Kingsley. The latter said nothing. He had met Crusard at various scientific conventions in the old days; they had even collaborated on a bit of research. But he trusted in the security of his disguise.

Crusard was tall and angular. His face was a thin, bearded mask; his forehead was a glistening expanse of intellectuality. But his eyes were glacial and merciless.

"So!" he repeated. "This alleged spy says nothing. Very, *very* wise—not like the usual run who play that fascinating game."

He walked slowly up to the American, a slight smile on his face, as if inwardly amused. He spoke conversationally. "You must know, my dear fellow, that we've been expecting you."

Still Kingsley did not move a muscle of his face. He stood quietly, unafraid, now that disaster was already upon him.

"Yes, we lost a valuable ice-sublimation tank as a result of the explosion of your plane. You no doubt had atomite bombs on board. You intended, my friend, to bomb our poor little project out of existence. A most laudable ambition—from your point of view."



He reached up suddenly, pulled hard at the beard which the American had grown. The action was so unexpected, the pain so intense, that Kingsley involuntarily cried out—in round American curse words.

The first shade of disappointment on Crusard's face at the naturalness of the beard gave way to a broad smile. But his eyes were cold, merciless probes.

"That good, vigorous American voice! The one thing you couldn't disguise. Now, in truth, I may call you my friend—my esteemed colleague, in fact. Welcome to the new realm of our glorious emperor—Mr. Frederick Kingsley!"

The American met his sarcastic glance with candid defiance. Mark Alden at least was still at large, overlooked in the focused attention on himself. "A rather pretty welcome, Crusard! You forget that our nations are at peace."

The tall scientist arched his eyebrows. "Peace?" he murmured. "There is no peace in nature. Everything is at war. And you forget, my friend, that you have come to spy. Even in so-called peace, there are certain penalties that relate to a spy."

Kingsley disregarded his veiled mockery. He came straight to the point. "You have done incredible things in this new land," he said. "They honor you as a scientist. Do they do equal honor to you as a man?"

Icy fire flashed in the gray eyes. Crusard clicked his heels. "In the service of the emperor all is honorable." Then he unbent, smiled. "What, in fact, do you know?"

"Enough to realize that what you intend bodes some harm to the rest of the world," Kingsley shot back.

"A very sensible deduction," Crusard approved. His eyes narrowed with cynical amusement. "But the exact means?"

"That was what I had come here to find out," was the bold reply.

"You shall," Crusard decided unexpectedly. "It will be a pleasure to disclose my dearest life work to the only other man in the world who can truly grasp its full meaning and majesty. In fact, you shall be a spectator to the mightiest engineering feat in all the universe. You alone of all the outer nations will have that honor."

Kingsley knew very well what Crusard meant by his invitation. But no sign of that inner knowledge appeared on his face. With equally polite mockery he demanded, "When will the unveiling of your masterpiece commence?"

"Within a week! By that time the continent will have been cleared of all its ice. Already the emperor is winging south with a huge fleet of battle planes; already the seas are dark with the ships and convoys of our nation, transporting a million select colonists, with all supplies, to the new land. When they arrive, and are safe in port, we shall begin."

Veiled words, through which a horrible premonition came to Kingsley. "Don't you fear disaster to the rest of your people—those who have been left behind?" he asked steadily.

"Our country is mountainous," Crusard answered cryptically, "and our people have received their orders. When all subsides, they will be transported here as well. And now, my dear colleague," he continued, "you must be confined until all is in readiness. Farewell!"

## V.

FOR A WEEK Kingsley paced his tiny cell in the bowels of the earth, seeing only the speechless guard who thrust his food through the bars, hearing only the dull echo of his steps, the buzzing round of his thoughts.

Crusard had played with him as a cat with a mouse. He had told him nothing, had hinted of dreadful things. Try as hard as he would, Kingsley could

not fathom what portended, what dreadful fate was about to overtake the world. He ground his teeth in helpless anger. He was immured like a beast, his own life forfeit.

But Mark was free! He clung to that desperately for a few days; then that faint hope also vanished. If Mark were still alive, he would somehow have managed to get word to him in his cell.

The days passed. The solid rock quivered and groaned with the increased beat of subterranean travails; the guard's dour countenance grew more and more exultant.

Then, on the seventh day, came a mighty burst of sound that penetrated even his fastness—a roar of human voices.

The emperor had arrived!

On the eighth day two guards came, instead of one. They unlocked the steel door. With pistols they prodded Kingsley along the steep passageways, back to the central dome.

It was transformed. The banners of the emperor festooned the rounded arch, fluttered from all the girders. A great dais had been erected at one end. It was crowded with officials, preened like pompous parrakeets in lace and ribbons. But they paled to drab insignificance compared to the grossly fat, stubby individual who reared on a solitary chair of state above them all. Diamonds, rubies, lustrous pearls, emeralds, star sapphires, iridescent opals weighted his uniform to a dazzling splendor. Yet they only accentuated the coarseness of his quivering jowls, the sordid cunning of his shifty eyes. The emperor!

Directly in front, before Kingsley's blinking eyes, was a gigantic televiser screen, gray with quiescence. He darted a swift glance at the recording dials. The giant orbs were saturated with mighty power; every superstorage battery brimmed with leashed energy. All was in readiness.

PAUL CRUSARD, bleak and intellectual as ever, seemed the least strained of all the multitude. He welcomed his captive with an ironic bow, waved him to a seat in front of the televiser. But the guards, pistols drawn, flanked him alertly. "Be seated, my friend," he remarked. "As a scientist you will thrill to what you are about to witness."

"And as a man, and an American?" Kingsley countered.

Crusard shrugged his angular shoulders mockingly, moved to the panel board with its wilderness of switches and snaking cables.

He turned to the emperor, made humble obeisance. "Before I begin, excellency, it is my intention to explain in detail the procedure, the methods I employ."

An annoyed look passed over the gross face, wiped away. After all, even the emperor could not afford to slight Dr. Paul Crusard, the engine of his anticipated triumph.

"Very well, doctor," he said ungraciously, "but be brief."

Crusard bit his thin lips. "I shall," he replied. "Three years ago, at your gracious behest, I began my experiments, investigated this vast territory of Antarctica. Our nation, superior in talents, in energy, in racial purity to all the world, was yet hemmed in a paltry several hundred thousand square miles of unfertile soil, of arid mountains, by the envious nations of the earth. We were dependent for coal, for iron, for the very food we ate, upon the sneering will of inferior races. This was not to be borne; our fertile people knocked at our frontiers in vain.

"Here, on the continent of Antarctica, however, was a vast, uninhabited territory, of almost four million square miles. I found unlimited coal, unlimited iron, great reservoirs of oil beneath the frozen surface. By a trick worthy of the mighty intellect of our noble emperor, the na-

tions, all unsuspecting, gave us title to this regal realm.

"Already, with the use of superelectromagnetic beams, I have sublimated the ice cap to molecular, gaseous condition. Even now these ice molecules, drifting over the tropics, have precipitated into heavy rains and torrential storms, puzzling the stupid scientists of the world. For this is normally the dry season.

"The uncovered soil of our new continent is incredibly fertile. For a million, million years it has lain fallow, while the accumulated débris, the filtering dust and life germs of the glaciers, have dripped down to seemingly eternal rest. Our fifty million people can double, nay treble, and still have further room for expansion."

The emperor shifted impatiently in his seat. "Come to the point, Dr. Crusard," he snapped.

A slow brick-red mantled the fallow forehead of the scientist. This should have been his supreme moment, and the emperor was deliberately putting him into his subordinate place. Yet he bowed humbly and proceeded.

"But the greatest of all problems remained. Hardy as we are, we could not hope to reach the fruition to which we are entitled in a region where, for ten months of the year, the thermometer hovers at seventy to eighty below zero, Fahrenheit. We must, therefore, make for our new land a warm and smiling climate, where all the grains, all the fruits, all the vegetables, even those of tropic climes, may grow with unexampled, lush fertility."

He paused, waved his bony arm around the great rotunda. "I have solved that problem! More, in the doing, I have solved others as well. No longer will the other nations of the world constitute a threat to our supremacy by reason of brute numbers, brute resources. They shall vanish from the earth, like the mastodon and

the dinosaur, whose bodies were mighty but whose brains were too dull for the struggle for existence; or, if some remnants remain, they shall be too weak, too exhausted, too preoccupied with the ceaseless battle against inimical elements, to be anything else but our subjects, our lowly slaves."

A HOWL OF CHEERS rocked the girdered dome. On every face was gloating, the lust for domination. Kingsley felt suddenly sick at heart. He was beginning to understand, to piece the dreadful picture entire.

"We shall," Crusard went on dramatically, "reverse the earth itself upon its axis, make that area equator which is now the poles, make that region polar which is now the tropics." He smiled cunningly. "But the twisting of the globe shall not be complete. We shall stop short of a full half turn. In other words, Antarctica, our future home, shall lie partly in the temperate and partly in the tropical zones, a garden flowering under the benign rays of the sun, while the northern hemisphere, the regions of our rivals, our despicable enemies, will revert to the ice age, and be buried under huge, remorseless glaciers."

Now the storm of wild cheers burst all bounds. Glutted hate, satisfied vengeance was marked on every countenance. Kingsley jerked from his chair, was thrust down with backhanded sweeps, by his vigilant guards. Lord! What manner of beasts were these, what manner of twisted brain was Crusard's, to conceive such an awful fate for billions of innocent human beings! Now, for the first time, he knew why the geographic poles had been chosen for the seat of the world-twisting experiment, instead of the magnetic poles.

There was a self-satisfied air on Crusard's countenance as he droned on. "To perform this operation, I have harnessed the mighty electrical forces of the sun, of the earth's own vast store of

magnetic energy, of the volcanic surge of subterranean lava. I have built them up, leashed these tremendous phenomena in apparatus of my own contriving. Now I am ready to let them loose. The result will be simpler than the complicated methods employed. Suffice it to say, that as I pull the master switch, and simultaneously therewith, Garth Sankar, my subordinate, pulls a like switch at the north pole, incalculable electromagnetic force beams will surge into the T towers, will crash out into space through the carefully focused cross tubes—but in equal and opposite directions. Here, at the south pole, the force beam is directed toward the constellation Hercules; at the north pole, toward the sun itself."

His eyes swung sardonically toward Kingsley, panting with helpless rage in his prisoning chair. "The principle is simple," he went on softly. "Newton's law of action and reaction. As the electromagnetic beams leap out, they kick back with an equal and opposite intensity. By special transformers, I have amplified the kick-back, braced it against the solid earth as at the fulcrum of a lever. The earth, urged in opposite directions by the applied beams at its poles, will turn on its center as on a pivot, until we have swung to a new equator, and the equator itself will become a meridian of longitude."

He turned, faced the emperor. "We are ready!"

The fat, bespangled man leaned forward. "Proceed!" he ordered.

The visor screens leaped into life. An asbestos-inlaid dome, twin to that in which they were, swam into being. A short, dark-haired man stared out at Crusard. Crusard nodded.

"Contact!"

"Contact!"

KNIFE EDGES sliced into copper grooves simultaneously. At once the great building shook and rumbled with

an earthquake roar; the ground rocked and vibrated underneath. With a howl, as of a thousand crashing, lightning bolts, the great electrostatic orbs spun on their gimbals, blazed with blinding sheets of flame. Rivers of blue fire raced through the wall vacuum tubes; the overhead magnets whirled in rotation so swift that they were but blurs of motion. The lifeless air crackled with electrostatic potentials; lambent sparks sang their frictional songs around the assemblage; each man's hair reared and stiffened upright like the locks of the Gorgon. The emperor paled, fell back cowering in his chair. The high officials on the dais clung paralyzed to their seats, hoarse cries smothered in their throats, fear explicit on every face.

But Crusard, over whom little fox fires danced and played, retained his preternatural calm. His somber eyes were fixed upon a subsidiary screen, on which a representation of the orbed earth appeared, spinning on its axis.

Kingsley, stunned, astounded, blasted by the din of sound, the overpowering glare of unleashed energies, followed his gaze. It was incredible, impossible, even with the limitless forces at Crusard's control, that he could fulfill his boast, and turn the vast, inertial earth as on a pivot.

But there, on the screen, even as he stared with unbelieving eyes, the pictured globe trembled, swayed gently to one side. Slowly, almost imperceptibly, yet with remorseless steadiness, its motion magnified by swinging pointers, the rooted planet turned from its immemorial poles, turned toward new axes and a new rotation. Slow the inexorable sway appeared on the screen, but Kingsley knew that they were toppling at the rate of a thousand miles an hour. Within less than six hours the required turn would have been completed, and an incredible new era commenced!

Crusard's calm voice, amplified by loud-speakers, raised above the howling

tumult. "There is nothing to fear," he said. "Antarctica is bottomed on the rocky substratum of the earth. I have calculated the strains. It will resist the shift of direction. So, too, will our native rocky land." He smiled thinly. "I cannot say as much for all the rest of the world. But while we wait, let us solace ourselves with the sight of those nations of the earth who once dared oppose our righteous mission."

The great televisor lighted again. In spite of his nausea, in spite of his horror, Kingsley could not help but look.

LONDON, ENGLAND! The Tower, the House of Parliament, Nelson's great statue in Trafalgar Square, appeared like dark oases in a beating, howling storm of rain. Above the clouds, the sun rocked steadily toward the south, dropping lower and lower on the horizon. Even as they watched, the rain turned to snow, to sheeted lumps of hurtling ice. The conglomerate masses crashed upon the buildings, buried them under tons of frozen water. A hurricane sprang up, howled upon the defenseless land with incredible fury.

The populace, like swarms of terrified ants, ran helter-skelter about the streets, shrieking and crying upon the remorseless heavens. The pelting ice crushed them to earth; the wild storm sucked them high, dashed them to ground again; the buildings toppled and buried them in vast debris, the mingled snow and ice reared in frozen drifts and stifled their lamentable complaints. The English Channel, the North Sea, inertial against the positive pull, reared up in a mighty tide one hundred feet in height, crashed with resounding fury upon the lowlands of England, transformed them in the twinkling of an eye to an inland sea of raging, tossing waters.

"One enemy is obliterated," Crusard spoke as if he were on a lecture platform. "Here, on Antarctica, we are protected from the worst effects. The

shift of position drains the winds and ice molecules away from us, toward the old equatorial belt, and we possess a mean elevation of three thousand to four thousand feet above sea level. Now let us turn to France."

Paris! Kingsley stared with dull despair. He had spent his youth in that gay city. Now it was a frozen blanket of featureless ice, from which the gaunt skeleton of the Eiffel Tower emerged like a prehistoric monster mourning its ancient dead.

Again the scene shifted. The emperor's realm. Here, too, the wintry blasts howled and roared, and the snow was falling thickly. But they had been prepared against the day. High in the mountains, in vast caves pre hollowed for their use, the population held vigilance. Thousands of cargo planes made serried ranks in special shelters, waiting for the storm to subside, to transport the people to their new land.

New York! Kingsley groaned and clenched his palms until the blood ran unheeded. Farther south than the great European capitals, the full fury of the change had not as yet reached that cosmopolitan city. But it was pitiful enough. A gale of a hundred miles an hour lashed the devoted city, the Rockaways were under water; the snow was already a foot deep in Manhattan; the Empire State Building, the Chrysler, the Woolworth, rocked and groaned under the fierce torsional twists of the earth's change of direction. The American government, acting with decisiveness, was evacuating the terrified people of the seaboard, carrying them inland.

China! Here was tragedy stark and naked. China, up the plateau of the Gobi, up to the rampart of the Great Khingan, was no more. Its low, teeming fields, its spawning millions, were buried under a limitless flood of yellow waters——

Already the luminous pointer hovered near the forty-five-degree angle, the an-



gle which, according to Crusard's calculations, would make Antarctica into a temperate and semitropic clime, and bury Europe and North America in eternal ice.

Fred Kingsley sat in a daze. His brain was numb with mingled hate and despair. Twice he had shrieked out wild denunciation; twice the guards had thrust him down with savage shoves and alert revolvers. There was nothing he could do now. Earth and all its fair civilizations were destroyed. Mark Alden was entirely obliterated from his mind. In the crash of a planet, what meant a single individual?

"And now," he heard Crusard through the agony in his brain, "we have almost reached the goal. It is necessary, therefore, to reverse the process, to apply our force in the opposite direction, so that the turning earth may be braked to a stop at the very point we desire."

Again the great televisor shimmered with the picture of the North Polar Station. Garth Sankar stared inquiringly from the screen.

"Reverse your force beam until further notice," Crusard ordered.

The short, dark man nodded briefly.

His hand reached for the master switch.

"Contact!"

"Contact!"

The earth cried out in shuddering torment at the tremendous strain. The machines howled and pounded with even mightier tensions. The great dome rocked and groaned. But the pointers of light on the subsidiary screen slowed down their forward march, approaching the forty-five-degree angle as an infinite limit.

"In half an hour," Crusard announced, "the earth will have stabilized on its new axis, and the era of our undisputed supremacy commenced."

In half an hour, the thought drummed in Kingsley's skull, the earth would be

wholly prostrate, the prey of these mad lusts after power, and he could do nothing to prevent it.

The din was frightful, the temblors more violent. All eyes were focused on the telltale representation of the spinning globe.

## VI.

A GUARD issued from the subterranean passage, walked swiftly across the heaving floor. No one noticed him. He was bearded and dark; his clothes were the drab gray of the soldier. A sergeant's chevrons were on his sleeve.

He approached Kingsley's guards with an air of command. "Here, you men," he ordered roughly. "You're wanted below on the last level. There's a break in the lava controls. All hell's beginning to break loose. Report to Captain Gorm at once. I'll take care of your prisoner."

The guards saluted, stared doubtfully. "But Dr. Crusard himself told us to watch this spy," one of them protested.

The sergeant's face grew black with anger. "Swine! Do you dare disobey an officer? Do you wish me to interrupt the great doctor in his work because you do not understand? Even now, while we stand gabbling, the lava is pouring through, will blow us all to hell if the leak is not fixed. Captain Gorm has ordered me to send him every man I could find to build new barricades. Begone, before I shoot you down like dogs!"

The soldiers wilted before the wrath of the sergeant. With muttered apologies they slunk off, eager to be away before he made good his threat. Kingsley, dead to all else but the terrible drama on the screen, felt a sharp dig in his ribs, a sharper voice in his ears.

"Quick, Fred, start for the tunnel—not too fast, not too slow. We want no notice."

He stifled the sudden exclamation in his throat. Obediently, he arose,

walked on steady feet, though his brain was throbbing, toward the opening that led to interlacing, intricate passageways. Behind him, alert, automatic a steady sheen against his ribs, walked the sergeant.

No one saw them go, or seeing, paid any heed to a commonplace shifting of a captive. And Crusard's back was to them, eyes intent on the controls.

Once within the welcome obscurity of the tunnel, the scientist cried out in strangled, incredulous tones. "Mark Alden! How—when?"

Mark's voice cut through like a knife thrust. "No time for explanation now. I've been hiding, slinking along miles of underground corridors, listening, getting the lay of the land. I had to kill a sergeant who got suspicious. I took his chevrons. But there's no time to lose. Your disappearance will be discovered soon, and there'll be a man hunt. We've got to make the most of our short liberty. Have you found out the mechanism of what Crusard is doing?"

"Yes."

"Good. What can we do to stop him?"

"Nothing!" Kingsley's words were dull, round pebbles falling into bottomless pools. "Nothing at all. Unless we can capture the dome, gain control of all the mechanisms."

"Stop talking nonsense, man," Mark rasped impatiently. "There are a thousand armed men in there, with fifty thousand more at call. Think! Think hard! I took you along because you're the scientist. I'm not. Every second is precious."

Kingsley thought hard, thought with an intensity that started beads of perspiration on his brow. Mark crouched beside him, sweeping the corridor with anxious glances, finger taut on trigger.

A light dawned on the scientist. "There is a way," he jerked out, "a million-to-one chance. Do you know

where the television controls are housed?"

"Yes."

"Swell! Take me there as fast as possible."

"Follow me."

MARK dived down an intersecting tunnel, Kingsley directly on his heels. Barely had they merged in the sheltering darkness when heavy boots pounded up the main passageway. Two trembling soldiers, headed by a scowling officer with the insignia of a captain on his shoulders, were rushing to report the fraud that had been committed on them.

Mark, unknowing, sped through the maze without a single pause, a single hesitation. He had used his skulking liberty to advantage. The ground rumbled and rocked beneath them as the earth slowly braked to a halt. In a minute more stability would be achieved, and the orders sped on the tight-beam ether channel to the north pole to cut off the power.

Mark stopped abruptly, raised his hand for caution. Before them was a door, transparent, of heavy, shatterproof glass. On the other side, the tunnel widened into a chamber. Visor screens made profusion in the interior; a hundred thick cables penetrated the walls in all directions, came to jointure on a plugger panel. Two men were inside. One sat before the board, making rapid connections, disconnecting other lines. The other lounged at his side, a gun peeping out of his holster.

"In another minute it will be too late," Kingsley whispered in anguish. "We've got to get in before then, or else—"

Mark tensed, hunched his powerful shoulders, crashed headlong into the door. The glass starred with cracks, but did not splinter. Yet the lock, already weakened by the strain of unimaginable forces, ripped, gave way. The door fell inward with a terrific

crash. Mark catapulted headlong into the room. Fred Kingsley was right behind him.

The guard whirled at the racket. His gun whipped out of its holster. Mark shot him through the heart. He fell without a cry. The visor-screen operator turned ashen face, reached desperately for a plug to spread the warning. Mark shot him, too. He slumped down in his chair, his nerveless fingers slipping from the warning signal.

"O. K.," Mark said grimly. "Strut your stuff, Fred. They'll be down upon us shortly. I'll guard the entrance while you work."

Kingsley shoved the dead man callously from the chair, flung himself into it. Precious seconds passed while he familiarized himself with the controls, with the code of the various stations on the chart that hung above the board. Already signals were buzzing impatiently, as Crusard in the central dome clamored for connections.

Then the scientist set to work, racing against time. He snatched up a huge cutting shears from the chest of repair tools next to the board, snipped all cables but the single one that connected with the outside world beyond Antarctica. Then, just as deliberately, he crashed the visor screens. Only the solitary outlet of radio was left, without television. He plugged that in, on a special beam, hunched over in an agony of waiting.

Mark, straining ears to catch a certain far-off uproar, faint above the creaking and groaning of earth itself, said without turning his watchful gaze, "Time's almost up, old man. I hear them coming."

THEN A VOICE spoke out of the amplifier. "I hear your signal, south pole, but I don't see you on the screen."

It was the voice of Garth Sankar, keeper of the North Polar Station.

Kingsley spoke, and Mark jerked his head back in surprise. He could have sworn that he had heard Dr. Paul Crusard in the room. The scientist's tones were calm, slightly nasal, supercilious. "There has been a break in our apparatus, Garth Sankar," Kingsley imitated. "The earth convulsions have been more intense than I anticipated. Only this single radio line is left for communication, and I expect it to snap any moment. Listen to me carefully, and follow orders."

"There has been trouble. We have been attacked by the combined aerial fleets of the world. They have cut our power. We are insulated, fighting desperately. On you depends the future of our people. Set your force beam with an automatic stop for nine hours, sixteen minutes exactly from now. Never mind why; there is no time for explanations. Put all your men on the battle planes, hasten south to our aid as fast as you can travel. Hurry!"

"But I don't understand," said Sankar's humble, yet worried voice.

"Hurry! Hurry!" Kingsley interrupted in sudden, assumed anguish. "The enemy is here; they are—" He reached over, snipped the last remaining cable.

"They *are* here," Mark told him calmly. The chamber reverberated with gunfire. Down the long corridor were shouting, running men.

Mark fired again. The leaders stumbled, fell. The rest pressed on.

Life would soon be over, but Kingsley spent his last moments in smashing the panel board, detector tubes, grids, in a veritable orgy of destruction. It would take days to repair the damage, and in that time—

Mark flung a last bullet into the close-pressed, shooting mob, whirled on his friend. "Come on; we're going places!"

"Where to, and how?"

"To short-circuit the T tower. Get through the door in back of you."

Kingsley swung around. He hadn't seen the inconspicuous exit. He made for it—just in time. Steel slugs sang their song of death and destruction all around them. Mark refilled his clip as he ran. Howls of rage followed them—howls and swift pursuit.

But Mark, at each turn, flung deadly lead at the foremost, and gained additional breathing space. The wrenching, earth-ripping quakes had ceased. The silence of the elements was more ominous than the loudest roar.

Mark's face was grim as he sped through devious paths. "Crusard has cut the power," he panted.

"I figured on that." Kingsley labored for breath. "I gave Sankar double time to make up for it."

"Crusard can rig up an emergency radio to countermand your orders."

"Let him. By the time he establishes communication, no one will be there. Sankar and all his men will be flying here to help repel a mythical invasion. The only thing that worries me is that Crusard will reverse his power here, and neutralize the force beam at the north pole."

"That's why," Mark interjected, "we're going for the T tower."

They saved their breath for the grim business of running. They had outdistanced pursuit, but the gap was not wide. And Crusard would have brains enough to rush troops outside to all the exits.

Then light dawned ahead. Not the artificial light of the passages, not the dim twilight of the polar sky, but hot, blinding, dazzling sunshine. The sunshine of Florida, the blazing brightness of the sands of Nice. They emerged on a scene of tropic splendor. The south pole was unrecognizable.

A huge sun rode high in the heavens, the once steel-hard earth was soft and

crumbly underfoot. The heat was intense.

THEY CAME OUT in the very shadow of the T tower. And, even as they did, the huge structure quivered; there was a rumbling, grinding noise, and sheeted bolts that paled even the glaring sun itself hurtled out of the cross tube with a roar that threw them flat on the ground.

"Crusard's done it," Kingsley yelled through the din as they picked themselves up, bruised, battered, shaken. "He's fighting the polar station, neutralizing its beam."

The tortured earth groaned again; the sun, which had slowly been ebbing toward the horizon, stopped its downward flight. And already, from every exit from the central dome, men were catapulting.

There was a bloody gash on Mark's forehead. In another minute the soldiers would be upon them. He grinned painfully. "Good-by, Fred!" he shouted above the terrific din. His grimy hand dug into his clothes, came out with a pellet as big as an orange. Kingsley's eyes widened on that innocent-seeming metal ball. Now he understood to the full the meaning of Mark's *good-by*.

"Throw it!" he screamed. Death no longer mattered.

Mark's arm went back. The steel casing flashed in the sun. The running men saw it, spun on their heels, raced back the way they had come, with cries of terror. The atomite bomb made a terrible, graceful arc, contacted the steel round of the giant tower.

The whole world seemed to heave and explode in one flaming concussion of sound. Tower, earth, sky, running men, central dome, collapsed in inextinguishable ruin—

Slowly, the impersonal sun, unwitting of the sudden, smoking silence that

lay beneath its burning gaze, sank once more to the horizon. Slowly, its fires quenched beneath the barren lifeless plateau; perpetual twilight wreathed once again the regions of Antarctica.

The ovened air, chilled with the withdrawal of its luminary, sucked high into the stratosphere; cooler winds from the north rushed in. A gale arose, more furious in its course, more vast in its consequences, than any earth had yet encountered. The howling winds flung themselves like solid walls of fury upon Little America, leveled the port in a ruining débris of destruction, crashed the anchored battleships of the emperor helplessly against the stony continent, crushed the battle planes like so much crumpling paper.


Far out at sea, the northward-speeding hurricanes caught Sankar's armada in its iron grip, flung it into the seething waters with contemptuous gesture. In the emperor's mountain homeland, the prospective emigrants crouched in their caverns, waiting for the signal that never came.

A MONTH LATER, when earth had returned to its former stability and ancient ways, and the remaining peoples of earth had dug themselves out of floods and melting snowdrifts and bemoaned their dead, an exploratory ex-

pedition of all the nations landed on what was once more the geographical south pole of the world. Elliot Dodd was in command.

A ghastly scene of desolation met his somber gaze. It was snowing, had been snowing for several weeks. Antarctica was taking back what had been wrongfully wrested from its frozen reign. Already five feet of hard-packed snow made a solid expanse; already the glaciers were forming. Here and there the searchers found gaunt steel ruins, drunkenly askew; within the frozen ground patient diggers found tumbled tunnels, the skeletons of men caught in tons of rock and falling dirt. But of Mark Alden and Frederick Kingsley, heroes who had saved the world and all its teeming millions from total destruction, there was no sign or trace.


Nevertheless, a requiem firing squad crashed out the last salutes to the buried men, who had died that others might live. And Dodd, in a voice made unsteady with emotion, spoke the last simple words. "They would have preferred it so. An entire continent is their grave; their monument the affection of their fellow men. What more precious fate could they have hoped for; what mattered a few more futile years of life against the immortal acclaim that now is theirs?"



*The cards are stacked against you*

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# Comet's Captive

*For hundreds of years radio had been  
a never-ending marvel—*

by Raymond Z. Gallun

LEAR JACKMAN looked at the needle clutched clumsily in the fingers of his space gloves, and then at the cold, death-wrapped glory of Arnaud's comet around him. The situation was far from humorous in its most important aspect; nevertheless, Lear Jackman laughed.

In part, this was because he had guts of that quality; but mostly it was because of Jane, his kid sister, age fourteen, back on Earth. She had pinned the needle into the last letter he ever expected to receive from her, a letter which he had picked up at Lescora, Venus, perhaps twenty hours before. Scribbled obliquely beneath the place where the needle had been thrust through the paper, he had found this inscription:

Sew on your own buttons, big boy!  
Spacemen must be bachelors!

Good-natured gibe—damned like the kid, scrappy little devil that she was! She understood the danger that dogged the tracks of every one whose business led them back and forth along the empty trails between the planets. And because she had often felt the poignant tension of waiting to be sure that he was safe, she understood, too, the fear of causing anguish and grief that had made him hesitant where marriage was concerned.

The knowledge that there was small chance indeed that he'd ever see Jane again brought Lear a sudden, painful

change of mood. With his free hand he reached into the breast pouch of his rubbertex vacuum armor, and squeezed the crumpled and impish missive which reposed there. In a way this act was like pressing her hand in farewell. At least it was the only possible substitute, now, for so doing.

"Don't know that I've ever done you much real good, Jenny," he muttered. "But my Venusian mine stock and my insurance will make you almost rich. That ought to help. When you get out of school you'll be able to buy a fleet of space rockets, if you feel like it, and I suppose you will."

Then, since there were things which were more important from the standpoint of duty than his own private obligations, Lear Jackman forced his thoughts from Jane and home. He tried to drop the needle back into the pouch from which he had absently taken it; but because he was badly battered and very tired from his recent misadventures, and because the heavy gloves which covered his fingers were scarcely designed for the handling of such small objects, it slipped from his grasp, and spun slowly in the swirling dust and stones of the comet's nucleus, which was all about the meteoric chunk of material, in a cindery hollow of which he clung.

For a few moments afterward the needle was visible in the spinning murk of cosmic refuse, its sharp point and eyeleted end exchanging tiny electric sparks with the heavily charged dust particles

that chanced to pass close to it. Then it was out of sight, lost in the rotating swarin that composed the center, and densest portion of this great, useless ghost of the void, in whose heart he was stranded.

HE DIDN'T TRY to recover the needle, even though impractical sentiment made him want to do so. Instead, he surveyed his surroundings, searching them again for some way to master what seemed a hopeless situation.

Though Arnaud's comet was moving toward the Sun, and was almost as close to it as Venus, still the solar light, seeping through the murky substance of its nucleus, was dim and red, as if seen through a Sahara sandstorm. The Sun's disk was visible only as a vast, fiery blob of irregular shape. The comet's tremendous, fanlike coma was dim, too, as was its colossal, million-mile-long tail, which was swept backward by the negative repulsion of the solar radiations. But this faintness of coma and tail was caused by the same circumstances which subdued and reddened the Sun's light.

Seen from clear and unobstructed space, Arnaud's comet would have been a glorious spectacle, glowing with a weird, greenish-white luminescence, induced both by outpouring electrical emanations from the solar vortexes, and by similar radiations generated here in the nucleus by the erratic flow of electrical charges that the friction of countless meteoric fragments and particles produced.

In the rarefied gases which existed here, sound could not be transmitted for any distance; but the ominous ping of small, pebblelike missiles, striking Lear's armor and glassite oxygen helmet, was, of course, plainly audible to him. In most cases he would not have needed ears to know that he was being hit; for when fragments collided with the body portion of his attire, he could feel their

bruising thrusts painfully, even through the stout, wire-reinforced fabric.

The velocity of the missiles was not great by ordinary standards, being usually very much less, even, than that of a slow bullet; for the gravity of the comet's core was insufficient to fling them around in their circular paths at anything like the terrific rates often attained by debris in space. Nevertheless, they moved fast enough so that, sooner or later, if Lear did not find a way to avoid them, the impact of one would cause a large breach in the attire which was his only protection against the almost pressureless and heatless chaos around him.

He grinned ruefully as he realized that his chance of dying from thirst, starvation, or the depletion of the energy unit of his air purifiers, was an extremely remote one. His end would undoubtedly come sooner than was possible from any of these causes.

But he mustn't die—not until his job was done, at least! Suddenly, he felt startled at that strange, indomitable, and unreasoning hope within him. Until his job was done, indeed! How, except by a miracle, could any such thing be realized?

AS IF to assure himself that his position was real, he groped to his waist, where a thick, foot-long cylinder of aluminium was fastened. Men had perished in the swamps and jungles around Lescora, that the precious contents of that cylinder might be collected. And he had been intrusted with the task of conveying it safely from Venus to Earth.

There was Craso in the cylinder, Craso, named after its Venusian inventor, who had learned to extract it from certain very scarce algæ which grew in the hot lowlands of his native sphere. No method of producing it synthetically had yet been devised, though it was the one means of combating, by intravenous

injection, the horrible blood disease Tarwan, accidentally introduced to Earth from its Sunward neighbor a short time ago, and now raging and spreading over a quarter of the planet.

To save the cylinder of Craso—to bring it to Earth intact—would mean life to hundreds of thousands, and perhaps even millions, of human beings; for not only would it cure those who were sick, but by so doing it would also check the development of fresh cases of the fearful Tarwan.

Lear Jackman's embarkation at Les-cora had given him no threat of danger. During his varied existence he had undertaken many missions which had seemed far more precarious at the outset. The great Earthbound space rocket, *Hermes*, had been comfortably and almost luxuriously equipped. But no mechanism that holds within its vitals the colossal forces needed to bridge the titanic gaps between the planets can be entirely safe.

What had happened, was to Lear,



*In the archaic Morse code, he spelled three letters of grim and urgent meaning: S O S!*

now, like a hideous dream that seemed to have visited him years ago, instead of only a few hours. With the other passengers, he had been admiring the splendid spectacle of Arnaud's comet, off to starboard. Then there had been a terrific, sense-blurring explosion astern.

Faces around him had paled. Lights had flickered on and off, speaking eloquently of the end; and, like a father gripped by the single thought of rescuing his child trapped in a burning house, he had scrambled to his stateroom and procured the cylinder which spelled the difference between life and death for so many of his fellow beings at home. Then he had clambered into a space suit. Before he left the stateroom, some vagrant whim had caused him to pick up Jane's letter, which had been lying on the table beside his bed.

He had helped to maintain order among the passengers during the tense and hectic moments of preparation to board the life rockets. But no one had had time to reach these little vessels of salvation. Another explosion had come, searing vision, and tearing flesh and metal alike. Lear had been crawling through a rent in the ruptured flank of the *Hermes*, when the third concussion had sent white-hot vapors steaming around him, and had hurled his unconscious form far out into the emptiness of the void.

HOW LONG he had remained unaware of what was transpiring around him was an interval the duration of which he could only guess at. But he had awakened, at last, to find this colossal, desolate grandeur of the comet on every side. He had fallen into its nucleus, evidently, attracted by its slight but dominant force of gravitation. And then, driven by instinct, he had scrambled through the pelting vortex of débris to the doubtful protection of this pit in the side of the great meteor.

He was still here in this refuge, to all appearances stranded irrevocably, and doomed to perish without the ghost of a chance to fulfill the vital duty which was his. He did not think of the other possible survivors from the wrecked liner. Their numbers must be few at best, and they were as helpless as himself. Other ships would respond to the *Hermes'* final call for help, of course; but that any one would think to look for him here was doubtful in the extreme.

But men like Lear Jackman are not made of the kind of stuff that accepts, or ever can accept, the dictates of adverse circumstances supinely.

He stared upward through the swirling hail of stones and dust, with a savage wish in his heart that he might glimpse, through that obscuring veil, the form of a rescue ship. But if such a craft was there in the vicinity of the place where the liner had met its fate, no single flame of its rocket nozzles could be seen through the obscuring substance of the comet's nucleus, and across the immense distance which the wreckage of the liner must now have attained, considering that it and the comet were both moving at vast velocity and in opposite directions.

And then a crazy idea came into his head. He knew that it was crazy, and hopeless of being successful, but he could think of nothing else. He would try to climb out of the comet's heart—out where he could see beyond that hellish haze of swirling refuse, and into the clear vacuum of the interplanetary regions.

What he might do should he somehow, by superhuman effort and luck, achieve this goal, he did not know. But perhaps some favorable chance would come to his aid then. Somehow, some one might detect his presence. Who really could be sure about what was possible and what was not? Why, not so long ago he had read in a magazine for interplanetary navigators, an article

which humorously described the adventures of some hypothetical hero who had ridden his way to Earth, from the asteroid belt, on a meteor! Lear Jackman was trying with his whole soul to be optimistic.

HE PUT every ounce of his strength and cunning into his attempt to realize his pathetic scheme. A thousand feet outward from the great fragment which harbored him, floated another, similar fragment. Between the two was a hurtling inferno of cosmic material of smaller caliber, yet he dared not hesitate.

His body tensed like that of an adder coiled to strike. In the next second he leaped with all his might. His armored form, almost weightless here where the gravity was so low, shot upward and kept going with only a gradual decrease in velocity. But even at that it would take minutes to cross the gap between the first and second large meteor. Even if he did cross it, he would have made only the first step toward escape from the comparatively tiny nucleus of the vast comet.

Fully exposed as he now was, the storm of cosmic wreckage struck him with all its force. He gasped raggedly under the drumming impacts, but gritted his teeth with fierce determination. Electric sparks from the charges carried by the fragments that hit him lanced against the insulating fabric of his armor. The latter had withstood the holocaust of missiles before, when he had fallen into the nucleus. Would it do so again? With luck it might be expected to do so, if the strain did not continue for too long.

Complete good fortune in adversity is, however, almost too much in demand. Upward and upward Lear floated, toward the large meteor which was his first goal. Then a chunk of stone as big as his fist whacked against his chest. His jaw dropped dazedly, and air bub-

bled from between his drooling lips. There was a taste of blood in his mouth.

He did not know what took place in his physical environment directly after that. He could only see, or seem to see, in the darkness that rushed into his mind like a black flood, the face of Jane Jackman, his young sister.

Incomprehensibly, as is the way with many dreams, she appeared to laugh at his misfortune at first. Then her eyes widened with concern. She said nothing, and she did not move; but held daintily in her fingers was a sewing needle, fuzzed with a brushy luminescence similar to that of the physical phenomenon which the fancies of ancient seamen identified as the spirit of St. Elmo, their guardian in time of storm.

The vision had no psychic implications, of course. Lear realized that even then, when his consciousness was blurring out. Though it was weird enough to excite the imagination of any one, there was nothing miraculous about it. It was just a figment created within his own head, from fragmentary impressions drawn from his recent experiences.

HIS THOUGHTS slipped into oblivion. But at last he awoke once more, to feel the languorous and velvety aches of a body whose metabolism had been severely disturbed by rough usage.

He was sprawled lightly on something hard, being held precariously in place by the attractive force of a very feeble gravity. There was no sunlight here at all, only the weird white-green glow occasioned by the migrations of electrical discharges within the center of the comet.

Slowly and dizzily he raised himself on one elbow, searching for evidence of what had happened. Then the pinch of despair tightened around his heart. His position was worse now than it had been before, as indicated by the complete absence of sunshine. His attempt to climb out of the nucleus had not only failed;



it had, in fact, caused him to drift downward to the very center of that nucleus!

The surface on which he lay was that of a gigantic and roughly spherical mass of rock and nickel iron. Around it the lesser bodies of the comet's core, including the myriad minute particles of dust, were rotating like satellites. He was now, surely, forever lost.

"Guess the game's over, Jenny," he muttered to his absent sister.

There was a tight grin on his face. His gloved hands fumbled absently with the aluminium cylinder which was still fastened, undamaged except for a few dents, to his waist.

His surrender brought Lear a curious, if fleeting, sense of relief. He looked about calmly, scanning the great fragment which was going to be his tomb. At least he was not being constantly bombarded by small missiles here, for the nearest of the moonlike fragments rotated at a distance of a hundred feet or so from their minute primary.

Then, all at once, a frown of surprise wrinkled Lear's forehead. There were things within sight that should not exist here. Out of the pitted crust of the vast lump that had trapped him, twisted, angular objects of metal were thrust. They looked like girders and beams and parts of machines; yet they were all invested with an intangible something which marked them as being relics which bore no kinship of origin with anything born of the solar system. They were not arranged according to any order. They were simply tangled and fused together, like scrap iron that had been partly melted in a furnace, and then allowed to cool.

But their meaning was clear. This huge, central fragment, and, in fact, perhaps the entire comet, was part of a once-inhabited world that had perished in a tremendous, fiery cataclysm which had happened an incalculable time ago, and doubtless at an enormous distance in space, for many comets are true

wanderers; they do not remain forever the captive of one star, but tear themselves free at intervals, to seek a new mistress.

The inspection of this visitor to the solar system, conducted by Arnaud and his subordinates, had evidently been sketchy; else the relics of a dead and distant race would surely have been discovered. Yet, in these latter days, such carelessness was not remarkable. Comets had been studied directly for many years, and though each differed somewhat from its fellows, no previously known difference was striking enough to arouse more than mild interest. Entering the nucleus of a comet was dangerous business, and now no one would expect that anything sufficiently new to justify the trouble could be learned by so doing.

TO LEAR JACKMAN, then, was granted the privilege of discovery. Even under existing circumstances he was not incapable of emotional response to the glamour of perished glories, mutely and dimly hinted at here. The presence of the tangled evidences of intelligent fabrication aroused within him a fresh surge of wild and almost irrational optimism.

Perhaps he could find some object, some mechanism, which might yet aid him to escape, and to get the precious cylinder to Earth. Who could tell? Wasn't it reasonable to suppose that outside of the explored solar system there were, and had been, civilizations whose sciences were far above those known to mankind?

Lear started to crawl toward the nearest of the relics, which was only a few yards away. It was not until then that he realized how weak and battered he was. His left leg was numb and swollen and frostbitten below the knee; it dragged limply behind him. In spite of its numbness, stabs of exquisite agony lanced through it at every move that he made. There was no doubt that it was

fractured. The injury had evidently happened while he was unconscious, during the time that he had drifted down here to the core of the comet's nucleus. A heavy fragment had struck his leg, and it had not only broken the bone, but had also punctured the stout fabric of his space suit slightly. For it was clear that air was leaking from the interior, dissipating his body warmth, and causing that chilled, numb, frostbitten sensation.

Lear paused, and, taking a piece of cord from his pouch, bound it firmly around his injured limb, just above the knee. This precaution would at least check the escape of vital oxygen from the upper part of his armor. Then, heedless of the pain, he continued with his crawling toward the other-world wreckage.

His inspection of the latter consumed several minutes; but he found nothing miraculous, or even, to obvious appearances, useful. His wild hope, born of the eager will to do his duty, seemed once again to have proved futile. This was exotic and intriguing junk, yet its practical status remained unaltered. It was still just junk, to all appearances worthless in his present predicament.

There were many rods of silvery metal among the tangle. Several of them were practically undamaged by fusion, and could be twisted free from the other encumbering metal parts without much trouble. These rods were all about a dozen feet in length, and were sharply pointed at either end. What their original purpose had been, Lear could not guess.

He looked at those rods with mild curiosity, now that he was satisfied that they could be of no help to him. Perhaps it was quite natural that they should suggest needles to him—ordinary sewing needles such as the one Jane had stuck through the letter she had written him.

NEEDLES? Needles had points. He frowned at the thought. Points and electricity. What was it that he had learned at school about points and electricity?

Well, if a pointed object harbored a static charge, the highest concentration of that charge was at the point. And from that point the electricity was apt to shoot out, like water from the nozzle of a hose. These facts formed the basis for a number of interesting phenomena, St. Elmo's Fire among them. Before electrical storms, and under the right conditions, this ghostly phosphorescence was wont to cling around the peaked tops of lofty objects.

All of which meant just what, now? Lear Jackman didn't know exactly, but he had a vague thought of producing luminous signals. He was aware that the meteoric mass under him was heavily charged. All the fragments which made up the nucleus of the comet were like that, and there was a continuous though erratic exchange of charges between them.

Lear Jackman was not very hopeful now, maybe because his strength was at low ebb; yet he proceeded with his feeble, despairing scheme with a kind of bulldog determination.

Working feverishly, he twisted two of the rods free, and grasped one in either hand. They were far from heavy here, where the gravity was almost nothing. He dragged them to the crest of a ridge, which traversed the huge, central lump like a miniature mountain chain. Around each upward-jutting serration of the ridge was a faint, brushlike fuzz of cold light, related to, if not exactly duplicating the thin gases which existed here, the St. Elmo's Fire of Earth.

Lear had a definite reason for selecting the ridge top as the site for his experiment. It was higher than any other visible portion of the tiny, planetlike body; and on high ground, particularly

near the pointed serrations, the electrical charges would be most concentrated.

Now he raised his two rods erect, setting their sharp, downward ends firmly against the surface of the meteor mass. At once a halo of cold flame enveloped their upward extremities, as electricity drawn from the cosmic lump on which he crouched jetted from the needlelike pinnacles, and caused a kind of fluorescence in the tenuous gaseous substance that enveloped them.

Viewed against the swirling, ghastly lighted grandeur of the comet all about, the trick Lear had produced looked feeble indeed. Could any one see his lights through the veiling chaos of rotating cosmic débris, granting, even that any one was there in space, and near enough to make detailed telescopic observations?

Jackman was not fool enough to suppose that such a thing was possible. He couldn't even see the Sun. How, then, could he expect that the emanations of his comparatively tiny lights could penetrate the murk in the opposite direction?

But he was definitely not a futilitarian. Reason, here, did not form a block to the continuation of his scheme; for there was nothing better that he could think of to do to try to help himself, and he must do something. And so, helplessly yet doggedly, he proceeded to carry out his plan to its last detail.

IN UNISON, he raised the sharpened bases of the rods clear of the surface of the meteor mass. Immediately the light of electrical discharge around the needle-pointed tops dimmed, as the direct contact of the metal with the crude, rock-flawed alloy of the great fragment was broken. There was only his body, and his heavy composition armor, to act as conductors now, and both were poor in that capacity.

Briefly, he held the rods away from the shell of the meteor mass. Then he

made contact once more, and the twin auræ of cold phosphorescence burned again. Three times they flared up together for a short moment. Then, by raising and lowering them slowly, Lear caused three longer flashes to blaze around their pinnacles. And, at last, he repeated the initial three short flares. In Morse Code, archaic, and of little common use in this age, he had spelled three letters of grim and urgent meaning: S O S!

Now he proceeded to say other things in the ancient dot-and-dash alphabet: "Lear Jackman calling! Lear Jackman calling! Drifted into nucleus of Arnaud's comet after wreck of *Hermes*. Have cylinder of Craso! Have cylinder of Craso! Come pick me up! Come pick me up! S O S! Lear Jackman calling——"

Over and over he repeated the message, until the process of doing so became almost an agonizing habit, which seemed an inescapable part of the torturing nightmare in which his weakening body and dimming mind appeared to be submerged. His face, haggard and dazed and sweat-streaked, behind the transparent shell of his oxygen helmet, shone ghastly and cadaverous and stupid, like that of some hideous gargoye, with each flickering blaze of cold light from his crude signaling device.

Gradually, but inexorably, the numbness was creeping upward from his shattered leg. It wouldn't be long now before all his activities must cease forever, blotted out by the dreadful cold that was finding its way into his space armor through the tiny rent in its fabric.

Still, when he was no longer able to move both of the rods, he continued to move one, up and down, forming light signals with a rigid fixedness of purpose which it seemed that only death could end.

"Jenny," he muttered again, addressing the sister who was millions of miles away, on Earth, "your needle gave me

this dumb idea. No good. Nobody'll ever see my signals. Impossible through all that rotating dust and rubbish. But it's not your fault, kid. Glad you had an idea to give me, even if it wasn't any good. Best luck, Jenny——"

HIS THOUGHTS were very dim now, his movement of the rod fumbling and uncertain. It must have been seconds after the white-hot flames of rocket nozzles appeared above him, that he was able to realize that there had been a fresh and unforeseen development.

Looking upward into the swirling, sparkling glory of the comet's heart, he saw a tiny craft descending. It was oval, and very heavily armored, being a small, specialized kind of vessel, which larger space ships frequently carry. The most common function of these stout midgets is to fly ahead of their parent craft while meteor swarms are being traversed, so that they can signal back the positions of the larger and more dangerous masses. Only a rocket of such small size, and with such a tough shell, could have penetrated with any safety into the chaotic maelstrom of the comet's core. A larger vessel would almost certainly have collided with a meteor big enough to wreck it.

The reality of the craft's arrival left Lear Jackman speechless. Within a minute it had come to rest beside him. The process of being carried from the harsh desolation of the great cosmic fragment, through an air lock, and into the small ship's warm cabin, held somehow for Jackman the aspect of a wonderful illusion which he could not believe in at first.

His glassite helmet and his bulky armor were removed. Two voices conversed around him. A bottle containing some warming, tasteless fluid was held to his lips.

While his injured leg was being attended to, Lear Jackman found his voice.

"Thanks!" he blurted unceremoniously. "The cylinder of Craso—— I—I can maybe get it to Earth now!"

"I guess you can, fella," the old officer who was one of his rescuers, responded. "They need Craso on Earth plenty. Our mother ship, the *Silver Shadow*, waiting just outside the comet's coma, is headed for Chicago. Captain Ornsbey called a halt when we picked up your signals. A freighter named the *Dove* took care of the other survivors of the *Hermes*. We——"

"Did you say you picked up my signals?" Jackman interrupted sharply. "How the devil could you see them through all the spinning stuff that goes to make up the middle part of this comet?"

"See them?" the old officer shot back. "We didn't, of course. We picked them up on the radio. We wondered how you produced them. Better tell us your story, fella."

Lear gasped in sudden realization. For hundreds of years radio had been a never-ending marvel; and it had gradually been perfected and refined until it had reached a wonderful degree of sensitivity. Long ago it had been able to detect the electrical disturbance of a ringing doorbell in a neighbor's house, and the similar disturbances of vacuum cleaners or X-ray machines. Here, then, was the explanation! His crude but ingenious method of signaling had not only produced flashes of light; it had also produced powerful and corresponding electrical agitations, which had transmitted waves to the surrounding ether. Those waves had borne his plea intelligibly to the *Silver Shadow*! Why, it was all childishly simple and logical!

LEAR EXPLAINED everything slowly and lucidly, telling just what had happened to him, and not forgetting to mention the alien source of the rods he had used. "Maybe that junk from the

Outside will interest the big boys at the Smithsonian," he remarked, with a knowing grin, as he finished.

"It will, all right!" the officer agreed at once. "We saw the stuff when we went out to fetch you. When we're all aboard the *Silver Shadow* we'll flash the news to the Smithsonian Institute. Oh, by the way! I know your name's Lear Jackman, because you mentioned it in your call for help. I'm John Randall, first mate, and this is my daughter Agnes, who is our radio operator. It was she who received your signals."

Somehow Lear had scarcely noticed the girl until this moment. She was not an obtrusive sort. There was no visible boldness about her; but when he looked at her now, he felt, back of her dark, quiet beauty, a strength and comradeship understanding which probed close to his heart at once. She knew the void; she knew its dangers, and she was not afraid of them; they were part of her life, too. They'd have to be part of it, just as they'd have to be part of his life, for the myriad ties which root one to home are deep.

The man and the girl exchanged the usual formal greetings. Then Lear's tongue loosened a trifle. "This looks like an honest-to-gosh lucky day for me," he remarked with a grin.

Agnes shrugged like an old dog of

the void. "You're doing your job, and you're alive," she said. "And—oh, well—who knows?" She smiled as if she read his thoughts and was not offended.

Lear, battered and aching physically, was happy to the very center of his being. With the precious Craso safe now, the Tarwan plague, raging on Earth, could be checked. There were rosy possibilities in the future, and he'd see a certain lovable and mischievous little imp again—a little imp for whom he had reason to feel a mighty gratitude. Jenny would be a lot like Agnes in a few years.

Then, suddenly, Lear chuckled. "Spacemen must be bachelors," was what he was remembering.

Agnes Randall's brows knitted questioningly. Lear looked at her, and then turned his gaze toward the instrument panel, where the girl's father was preparing to guide the small craft back into space.

"When we reach the *Silver Shadow* I've got to radio love and kisses to my kid sister," Lear explained. "She helped plenty to save my neck. No, don't ask now what I'm talking about. I'm thinking of a funny story that concerns a needle stuck into a letter. There was something written alongside the needle, too. But I suspect now that it's a lie."

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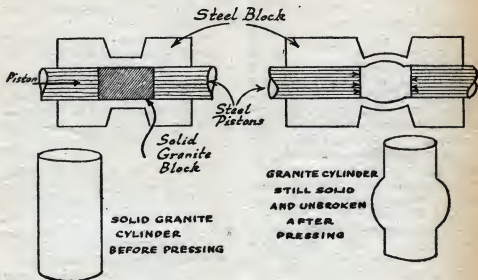


# STRESS-FLUID

*There is a fourth state of matter—  
A science article*

by Arthur McCann

FIG. 1.



THERE IS a fourth state of matter, one more than the classical solid, liquid and gas. What of a substance that possesses true crystalline form, and at the same time can transmit pressure as a typical hydraulic medium would? In various laboratories this condition of matter has been demonstrated in apparatus such as that diagrammed in Fig. 1. A hard, brittle, crystalline solid, such as a cylinder of granite, is placed in a specially prepared steel block. The steel is machined to fit the granite very closely, and is then weakened at one spot by grooving it deeply. At each end, powerful steel pistons are inserted,

and gradually, an immense pressure is brought to bear on the inclosed, brittle rock.

In an ordinary testing machine granite can be stressed to a certain point, when, finally, this unusually strong rock must yield. The crystals snap; the rock crumbles. But in this steel block, the limit of strength of the granite is reached, and passed; the granite bears a load which its strength is entirely incapable of carrying without fracture, but it literally has no room to crack. It cannot escape the intolerable load, since it is confined on every side. A liquid could escape that condition; it would transmit the hori-

zontal thrust of the pistons to the weakened walls of the steel block, forcing them to yield.

As though it did, in fact, contain a liquid, the steel block bulges gradually—weeks are needed for the experiment. Finally, the pistons are released, the steel block cut open, and the granite taken out. It remains a single, solid, unbroken piece of rock. It has flowed in true liquid manner, without cracking or chipping, and remains a solid, brittle piece of stone.

It is an interesting experiment and can be duplicated with any type of stone, or any other material, so long as a stronger, harder material can be found to form the pistons and block. It is no surprise that steel can flow under pressure, but that quartz or granite will do the same seems, perhaps, an interesting, but rather useless fact, since no immediate application for rolled granite sheets or granite I-beams appears.

A very large proportion of the planet we live on consists of material of just that nature: stress-fluid. Practically speaking, there is no "solid" Earth, and *terra firma* is merely the deceptive stability of Titan's barges, floating on a 4,000-mile-deep sea of stress-fluid.

A moment's consideration will make it perfectly evident that the Earth could not possibly be solid. One mile down in land of average composition, the pressure has risen to 450 tons per square foot. Two miles down, and it reaches 900. There are four thousand or so to go; can you conceive of a substance that would be supporting a load of two or three million tons per square foot? Certainly no natural substance known even approximates such resistance.

Actually, the hardest rocks flow like mud within twenty miles of the surface; where pressures reach 9,000 tons per square foot. Within the first 1/200th of the Earth's radius, the toughest rocks are already converted to that condition

of fluid-by-force-of-circumstance: stress-fluid. The surface of the planet as we know it represents practically all the true solid matter on the planet, and that surface, then, must be floating—floating by true, natural buoyancy, the upper surface of immense bargelike boats of solid rock. Twenty miles or so in their draft, mountain, desert, lake or ocean is their cargo. Each Titan's boat has an area of hundreds or thousands of square miles, side by side. Pressed close against each other, they float on the immense liquid sea that constitutes practically all of the planet.

THAT makes clear at once several important things: First, we can be sure that no well, shaft or mine can ever be driven deeper than some ten or twenty miles into the thin crust of the planet; not because of heat, but because of the jets of fluid-solid rock that would instantly fill them. The fabled caverns that lead, level on level downward, to the center of the Earth, are likewise impossible; no rock could possibly resist the inconceivable hydraulic pressure of that stress-fluid. The Zone of Fracture, geology calls that surface scum of true, solid rock, because it can crack, and by its solid condition maintain a cavity, a fracture opening. Below the surface level the pressure converts rock to fluid; you cannot crack a liquid. That is the Zone of Flow.

But it raises another question: if each of these planetary barges, or blocks, is in true buoyant equilibrium, how can the Himalaya Mountains, with the immense burden they must represent, be considered in floating equilibrium with, for instance, the Japan Deep, a hole 35,000 feet deep? How can the continent of North America, projecting an average of 2,300 feet above sea level be in equilibrium with the Pacific Ocean's bed, 14,000 feet below that level? It certainly seems that something very solid, and immensely

strong, were maintaining those unequal levels, for surely the Himalaya Mountains seem far heavier than the Japan Deep.

But—they are not. They are floating in true, exact equilibrium. Specimens of rock have been gathered from those mountains, and from mountains everywhere. And almost invariably mountain ranges are made of comparatively light rocks, granites and gray or light-colored rock. The light-colored rocks are generally light in weight, while the black and dark basalts and igneous rocks are typically dense materials. Where mountains are made of the gray and light rocks, sea bottoms yield—to the deep-sea dredges—dark, very dense matter. What samples we have indicate that the density of the one offsets the height of the other.

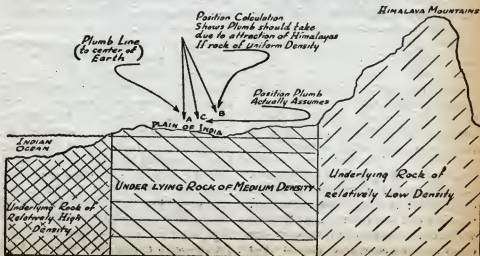
India offers a considerable range of elevation within a short distance. The ramparts of the Himalayas tower 4 miles into the air, sloping off, to the south, into the broad, level Plain of India. Farther to the south this peninsula of the Asiatic continent tapers off into the Indian Ocean. It would be ideal if we could get some indication not only

of the surface-rock density, but also of the density of the underlying material. For though that five-mile peak of Mount Everest represents  $\frac{1}{2}$  to  $\frac{1}{4}$  of the total thickness of the Zone of Fracture, Mount Everest tapers off to a small area up there 5 miles, while the underlying material does not. If the planetary block carrying Everest is in balance, not only the mountain, but the underlie must be less dense than the average.

The same argument applies to all the mountains of the Earth: the Andes, the Alps or the Rockies. But in India we have a beautiful opportunity to make a direct determination of the density of rock 10 or 20 miles below the surface. We cannot reach down to that level for samples, but the rock does reach out to us, as does every particle of matter in the universe, with a force varying inversely as the square of the distance: gravity.

Fig. 2 represents the general method, though, of course, simple plumb lines are not used. More complex and delicate instruments are required. If the surface and underlie rocks were all of the same density, the plumb would give

**FIG 2** FACTORS EXAGGERATED FOR CLARITY



the direction to the center of the Earth, along Line A. The mass of the Himalaya Mountains can be estimated with some degree of accuracy, and they will naturally attract the plumb line away from the center line, A. The mass of the mountains above the ground should attract the line to the position B, if the density of the rock under them was equal to the density of that under the Plain of India. Actually, the line falls into Position C. There is a definite, detectable density deficit in the rocks under the mountains.

The thing becomes understandable; the Plain, then, rests on deep rock of considerable density, while the mountains are made of, and float on lighter stuff. Then, in turn, the sea bottom of the Indian Ocean is made of rock denser even than that under the Plain of India. Naturally, to be in equilibrium, this denser stuff has floated in the Zone of Flow at a lower level. A submarine, a tug boat and a cargo steamer may all have the same draft, sink an equal 18 feet in the water. But because the submarine has a high density, it rises only 2 or 3 feet above the water when floating. The tug, loaded heavily with powerful engines, designed only for sheltered waters of a harbor rises higher, perhaps 5 feet above the water, a sort of Plain of India. While the cargo steamer, of relatively low density, towers 20 feet or so above the water line.

IF EARTH, then, is made of immense blocks of rock floating in a sea of stress-fluid, what will happen if one is overloaded temporarily, say as by a flood such as recently inundated the Ohio Valley? That water represented billions of tons of loading applied to a floating, rocky, planetary block in equilibrium; if the theory is correct, why did that not force the block down somewhat, enough to be detectable. No doubt it would have, had flotation alone

been supporting it; but on all sides, close-packed, neighboring, planetary blocks were forced against it by immense pressures. At the deep ends, say 9 miles below, the pressure is almost enough to make the rock a stress-fluid, and great enough to make it weld slowly, by pure pressure.

Friction and that loose weld both tend to prevent slippage, save when the overloading is excessive. A block in good balance can bear an additional loading of billions of tons (since even that represents a comparatively small fraction of the total mass of its cargo) without motion.\*

However, if a load is continuously added to, or continuously subtracted from, the unbalance grows greater and greater, till eventually friction and rock weld both fail, and a new equilibrium is attained by flotation.

The Rocky Mountains are forever being gnawed by the 10,000 teeth of frost and sun, rain and wind-blown sand. The rock chips—the chips tumble downhill in rains—are ground to mud and carried away by the Titan's conveyor system Nature uses: the rivers.

Eventually, of course, the entire, vast mass of the mountains will be worn away; in comparatively short time, billions of tons are worn away. This is no temporary loss, as a flood is a temporary gain. It continues; the unbalance grows ever greater. Friction and weld are stressed beyond their limits—and snap. The motion upward takes place—a motion perhaps no more than one hundredth of an inch, but the result at the surface is devastating: an earthquake. To see how this may be with so slight a motion, hit the underside of a table top with a fairly massive

\* Since this material was written slight Earth tremors have been reported from the region of the Ohio floods. This, then, would indicate that the loads had actually been great enough to cause a slight, slow settling. Relieved of this burden of water, the planetary blocks involved are readjusting themselves.

hammer; the table itself moves perhaps a hundredth of an inch—but watch the objects on it dance!

Meanwhile, the rock mud is washed down from the mountains; the rivers carry it along, dump it in the Mississippi, and finally the father of waters reaches the sea. The salt water, the slowing of motion, combine to precipitate the dust. Gradually, the river delta is built up, and out into the sea. All the billions of tons are deposited gradually—the mountains carried to the sea. Here, inevitably, an opposite-type of instability is growing. The planetary block-bearing New Orleans is being continuously added to; the strain grows greater and greater—till rock and friction yield. New Orleans has occasional, slight earthquakes as the Mississippi delta settles to a new equilibrium.

But where does the stress-fluid in the deep Zone of Flow, displaced by this settling of the Mississippi, 'go'? It is forced out of its place here, cubic miles of it. It flows to a spot where there is room for it; not necessarily the same material, but equivalent stuff is forced into spaces opened by the gradual rise of the Rocky Mountain planetary section.

AS AGES PASS, then, the Mississippi-delta region sinks slowly, displacing the heavy material underlying it by the lighter rock washed down from the mountains. Gradually, then, there will be a change of density; the average density of the planetary block of the delta area is being lowered. Time will come when it represents a light section, and light sections are high points! The delta region will rise to a point that will force the river to seek a lower spot for its mouth.

A reverse action at the Rockies finds heavy, dense rock of the Zone of Flow gradually working upward, increasing the average density of the planetary section underlying the mountains. They

are growing heavier, slowly. The day will come when they no longer rise as high as they once did; the mountains will be worn away. But not before they have been entirely worn away twice over! To-day, for every inch worn away from them, they rise half an inch or so.

Ages ago, when the great glacier crept down from the North, it pressed southward toward the Great Lakes—lakes which were one vast inland sea—draining toward the Gulf of Mexico, down the ancient (even then) Mississippi. The St. Lawrence did not drain the lakes in that time. Slowly, the immense weight of the glacier crushed southward. Trillions of tons of new mass building up on planetary blocks in equilibrium. Slowly, they settled under that stupendous load of mile-thick ice.

Have you seen thin ice sink beneath an advancing skater, to build up in a wave before him, tipping slowly as the displaced water forced it up ahead? North America was thin ice before the advent of that cosmic skater. The entire Great Lakes region tipped, dipping beneath the toe of the advancing colossus. Cubic miles of stress-fluid, displaced by the sinking blocks, forced upward the blocks immediately in front of the glacier. The Lakes tilted; to-day they no longer drain southward, but northeastward.

But the strain is gone; the glacier retreated. Have you read in the papers that the Lakes are slowly tilting south?

Earthquakes result from the sudden attainment of a new equilibrium; they are phenomena involving the release of enormous energy in an almost explosive form, frequently arising at depths of 10 to 20 miles. The primary effects are, of course, felt at the surface of the planetary block involved in the slippage, though the immediately neighboring blocks naturally tend to share in the violent motion.



However, since the material of the Zone of Flow is a solid capable of flow only because of the immense pressure, it transmits the shock in a manner characteristic of its condition. By the study of miniature earthquake shocks caused by exploding dynamite, geological prospectors are locating mineralogical formations likely to contain oil. By the study of the vaster waves of natural earthquakes, we can learn about the structure of the deep, unattainable interior of the Earth in much the same way.

A bar of steel struck with a hammer transmits sound at a considerably higher rate than the less-dense surrounding air; it is for this reason that a listener at the far end of a long, steel rod hears 2 sounds: first the blow as transmitted by the steel and secondly the air wave. If the rock underlying the ocean beds is denser than that underlying the continents, then the rate of transmission of the stress-wave of an earthquake should be correspondingly higher.

This fact can be demonstrated. An earthquake wave originating in Japan travels entirely through ocean bed in reaching California, but through ocean bed, and then through the subcontinental rocks under North America in reaching New York City. By measuring the elapsed time in transmission of the waves received at two stations—one in San Francisco and the other in New York—the rate of transmission through ocean bed and through continental rock can be measured. These measurements confirm our belief that subcontinental rock is less dense than subsea matter.

But an earthquake shock wave as received at a distant station is immensely complex, made up of a number of elements. The stations 90° around Earth from the point of origin receive surface waves that traveled around the surface through the solid rock of the planetary blocks, and, in addition, the waves that

traveled through the stress-fluid of the deep interior. At lesser angles around the Earth the waves received have, of course, penetrated less deeply through the core of the planet. This makes it possible to determine the speed of transmission at various depths.

These studies have shown that, once below the thin, solid rock layer, the speed of transmission increases with depth, reaching a speed of 7.9 miles per second at a depth of 1,800 miles. The rate of increase with depth is greater during the first 750 miles, though the speed increases with depth more slowly to the 1,800-mile mark.

Below 1,800 miles the entire character of the waves change. To this point only the velocity varies with depth. At 1,800 miles there is a sharp alteration in the fundamental character of the transmitting medium, reflected in an equally abrupt change in the form and behavior of the waves passing through it.

And furthermore, just as a glass lens refracts and reflects light waves by its different density with respect to air, this core material reflects and refracts earthquake waves at considerable angles. Evidently, there is a very sharp, very large change both in the density of the medium and in the character of its constitution.

WITH THIS DATA, aided by the very important information furnished by analysis of the composition of meteoric material (which represents a sampling of cosmic matter), a considerable understanding of the deep interior of the Earth is possible. Apparently, beneath the surface scum of light rock, which averages about 3 in density, and extending downward 40 miles at most, a greater rock core begins. This consists of much heavier rock, averaging 4 in density—substance that would be very hard and strong were it free of pressure. 750 miles of this dense rock

surround an inner rock core, into which it gradually merges, without any sharp line of demarkation.

The fluid condition of the interior, brought about though it is by pressure rather than by heat, still permits of a density separation, settling of the heaviest materials toward the center. The dense rock zone surrounds an oxide-sulphide zone, composed, probably of the heavy oxides and sulphides of metals, the substances that, in relatively minute traces, are the ores supplying us with our metals here on the surface. But, beginning 750 miles beneath us, the rock is almost wholly composed of these dense ores. Attainable, they would become of incalculable value, containing billions of tons of our semi-precious metals, no doubt. In that layer, the quantity of copper ore, for instance, would be measured in billions of tons, as we measure its surface plenty in millions of pounds.

At 1,800 miles the sharp break in properties noted by the earthquake waves penetrating these deeps is probably due to the presence of an immense mass of pure, armor-plate steel! A mass of nickel-iron alloy more than 4,000 miles in diameter constitutes the core of the planet. The sharp break in transmissive properties between the lowermost levels of the oxide-sulphide zone and the upper surface of the nickel-iron core is due to an abrupt change in density from something

around 5.6 in the sulphides to over 8 in the metal.

There, forever beyond our reach, is an incalculable, Midas horde of the finest kind of refined steel. An alloy too expensive for wide use on the surface, forms a 4400-mile ball at the center of the Earth. Billions are inadequate to express the immense mass of that already refined, high-grade alloy; the tonnage is expressible in quintillions.

But, though there lies ready that immense wealth of refined metal, though in that deep, oxide-sulphide layer there must be inexpressible tonnages of silver, copper, mercury and lead ores worth untold fortunes, man will never tap them. If, in ages to come, some device of pure force fields, capable of resisting successfully even the stupendous pressures that make hard rock flow like mud, is developed, still those ores will be unused.

In that day man will not need to mine his minerals, and before that time no shaft, no well, no drill can ever penetrate those depths. Within 30 miles of the surface hard steel would soften and flow. The strongest bracings would be useless. Inevitably, the immense pressure of the superincumbent rock would force shut the drilled shaft. Should the drilling equipment be hoisted up from the depths, a jet of slowly, irresistibly flowing rock would thrust upward behind it, sealing again any attempt to open a path to the unattainable deeps.

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# FORGETFULNESS

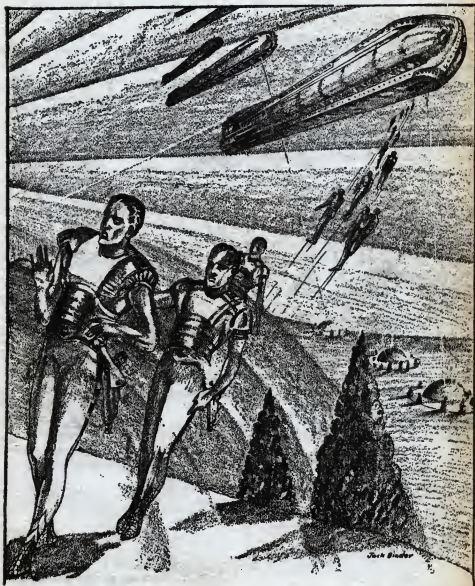
by DON A. STUART



**R**ON THULE, the astronomer, stood in the lock gate and looked down across the sweep of gently rolling land. Slowly, he breathed in the strange, tangy odors of this planet.

There was something of a vast triumph in his eyes, and something of sorrow. They had been here now scarcely five hours, and the sun was still low in the east, rising slowly. Out beyond, above

*"Space of our own? No—it is like the sorgan: It rotates us to the end of time."*



the western horizon, a pale ghost of the strange twin world of this planet, less than a third of a million miles distant, seemed a faint, luminous cloud in the deep, serene blue of the sky.

It was triumph, for six long years of travel, at a speed close to that of light, lay behind them; three and a half light years distant was Pareeth, and the crowding people who had built and

launched the mighty two-thousand-five-hundred foot, interstellar cruiser that had brought this little band of one hundred. Launched in hope and striving, seeking a new sun with new planets, new worlds to colonize. More than that, even, for this new-found planet was a stepping-stone to other infinities beyond. Ten years of unbroken travel was the maximum any ship they could build would endure. They had found a planet, in fact, nine planets. Now, the range they might explore for new worlds was extended by four light years.

And there was sorrow there, too, for there was a race here now. Ron Thule turned his eyes toward the little clustering village nestled in the swale of the hills, a village of simple, rounded domes of some opalescent, glassy material. A score of them straggled irregularly among the mighty, deep-green trees that shaded them from the morning sun, twenty-foot domes of pearl and rose and blue. The deep green of the trees and the soft green of the mosslike grass that covered all the low, rounded hills gave it a certain beauty; the sparkling colors of the little gardens about the domes added color and further beauty. It was a lovely spot, a spot where space-wearied, interstellar wanderers might rest in delight. A village, indeed, where any one might rest in ease and enjoyment, after long, long labors:

Such it was. There was a race on this planet the men of Pareeth had found after six long years of space, six years of purring, humming atomic engines and echoing gray, steel fabric that carried and protected them. Harsh utility of giant girders and rubbery flooring, the snoring drone of forty quadrillion horse power of atomic engines. It was replaced now by the soft coolness of the grassy land; the curving steel of the girders gave way to the brown of arching trees; the stern ceiling of steel plates gave way to the vast, blue arch of a planet's atmosphere. Sounds died away

in infinitudes where there was no steel to echo them back; the unending drone of the mighty engines had become breezes stirring, rustling leaves—an invitation to rest.

The race that lived here had long since found it such, it seemed. Ron Thule looked across the little village of domes to the largest of them, perhaps thirty feet across. Commander Shor Nun was there with his archaeologist and anthropologist—and a half score men of this planet. Rhth, they called it.

The conference was breaking up now. Shor Nun appeared, tall and powerful, his muscular figure in trim Interstellar Expedition uniform of utilitarian, silvery gray. Behind him came the other two in uniform—young, powerful men of Pareeth, selected for this expedition because of physical and mental perfection, as was every man of them.

Then came Seun, the man of Rhth. He was taller, slimmer, an almost willowy figure. His lean body was clothed in an elastic, close-fitting suit of golden stuff, while over his shoulders a glowing, magnificently shimmering cape of rich blue was thrown. Five more of these men came out, each in a golden suit, but the draped capes glowed in deep reds, and rich greens, blues and violets. They walked leisurely beside the men of Pareeth. An unconscious force made those trimly uniformed men walk in step between the great, arching trees.

THEY CAME NEAR, and Shor Nun called out, "Is the expedition ready?"

From the forward lock, Toth Mour replied, "Aye, commander. Twenty-two men. What do these people say?"

Shor Nun shook his head slightly. "That we may look as we wish. The city is deserted. I cannot understand them. What arrangements have you made?"

"The men you mentioned are coming.



Each head of department, save Ron Thule. There will be no work for the astronomer."

"I will come, Shor Nun," called out the astronomer, softly. "I can sketch; I would be interested."

"Well enough, as you like. Toth Mour, call the men into formation; we will start at once. The day varies in length, but is some thirteen hours long at this season, I am told."

Ron Thule leaped down to the soft turf and walked over toward the group. Seun looked at him slowly and smiled. The man of Rhth looked taller from this distance, nearly six and a third feet in height. His face was tanned to a golden color that came near to matching the gold of his clothing. His eyes were blue and very deep. They seemed uncertain—a little puzzled, curious about these men, curious about the vast, gray bulk that had settled like a grim shadow over the low hill. Half a mile in length, four hundred feet in diameter, it loomed nearly as large as the age-old, eroded hills it had berthed on. He ran a slim-fingered hand through the glinting golden hair that curled in unruly locks above a broad, smooth brow.

"There is something for an astronomer in all this world, I think." He smiled at Ron Thule. "Are not climate and soils and atmospheres the province of astronomy, too?"

"The chemists know it better," Ron Thule replied, and wondered slightly at his replying. He knew that the man of Rhth had not spoken, simply that the thought had come to be in his mind. "Each will have his special work, save for me. I will look at the city. They will look at the buildings and girders and the carvings or mechanisms, as is their choice. I will look at the city."

UNEASILY, he moved away from the group, started alone across the field. Uneasiness settled on him when he was near this Seun, this descendant of a race

that had been great ten millions of years before his own first sprang from the swamps. Cheated heir to a glory five million years lost.

The low, green roll of the hill fell behind him as he climbed the grassy flank. Very slowly before his eyes, the city lifted into view. Where the swelling curve of the hill faded softly into the infinite blue of the sky, first one little point, then a score, then hundreds appeared, as he walked up the crest—the city.

Then he stood on the crest. The city towered before him—five miles away across the gently rolling green swale. Titan city of a Titan race! The towers glowed with a sun-fired opalescence in the golden light of the sun. How long, great gods of this strange world, how long had they stood thus? Three thousand feet they rose from the level of age-sifted soil at their bases, three thousand feet of mighty mass, stupendous buildings of the giants long dead.

The strange little man from a strange little world circling a dim, forgotten star looked up at them, and they did not know, or care. He walked toward them, watched them climb into the blue of the sky. He crossed the broad green of the land, and they grew in their uncaring majesty.

Sheer, colossal mass, immeasurable weights and loading they were—and they seemed to float there on the grace of a line and a curve, half in the deep blue of the sky, half touching the warm, bright green of the land. They floated still on the strength of a dream dreamed by a man dead these millions of years. A brain had dreamed in terms of lines and curves and sweeping planes, and the brain had built in terms of opal crystal and vast masses. The mortal mind was buried under unknown ages, but an immortal idea had swept life into the dead masses it molded—they lived and floated still on the memory of a mighty glory. The glory of the race—

The race that lived in twenty-foot, rounded domes.

The astronomer turned. Hidden now by the rise of the verdant land was one of the villages that race built to-day. Low, rounded things, built, perhaps, of this same, strange, gleaming crystal, a secret half remembered from a day that must have been—

The city flamed before him. Across ten—or was it twenty—thousand millenniums, the thought of the builders reached to this man of another race. A builder who thought and dreamed of a mighty future, marching on, on forever in the aisles of time. He must have looked from some high, wind-swept balcony of the city to a star-sprinkled sky—and seen the argosies of space: mighty treasure ships that swept back to this remembered home, coming in from the legion worlds of space, from far stars and unknown, clustered suns; Titan ships, burdened with strange cargoes of unguessed things.

And the city peopled itself before him; the skies stirred in a moment's flash. It was the day of Rhth's glory then! Mile-long ships hovered in the blue, settling, slow, slow, home from worlds they'd circled. Familiar sights, familiar sounds, greeting their men again. Flashing darts of silver that twisted through mazes of the upper air, the soft, vast music of the mighty city. The builder lived, and looked out across his dream—

But, perhaps, from his height in the looming towers he could see across the swelling ground to the low, rounded domes of his people, his far descendants seeking the friendly shelter of the shading trees—

RON THULE stood among the buildings of the city. He trod a pavement of soft, green moss, and looked behind to the swell of the land. The wind had laid this pavement. The moving air was the only force that main-

tained the city's walks. A thousand thousand years it has swept its gatherings across the plain, and deposited them as an offering at the base of these calm towers. The land had built up slowly, age on age, till it was five hundred feet higher than the land the builder had seen.

But his dream was too well built for time to melt away. Slowly time was burying it, even as long since, time had buried him. The towers took no notice. They dreamed up to the blue of the skies and waited. They were patient; they had waited now a million, or was it ten million years? Some day, some year, the builders must return, dropping in their remembered argosies from the far, dim reaches of space, as they had once these ages gone. The towers waited; they were faithful to their trust. They had their memories, memories of a mighty age, when giants walked and worlds beyond the stars paid tribute to the city. Their builders would come again. Till then—naught bothered them in their silence.

But where the soft rains of a hundred thousand generations had drained from them, their infinite endurance softened to its gentle touch. Etched channels and rounded gutters, the mighty carvings dimming, rounding, their powerful features betrayed the slow effects. Perhaps—it had been so long—so long—even the city was forgetting what once it was. They had waited, these towers, for—

And the builders walked in the shade of the trees, and built rounded domes. And a new race of builders was come, a race the city did not notice in its age-long quiet. Ron Thule looked up to them and wondered if it were to be that his people should carry on the dream begun so long ago.

Softened by the silence, voices from the expedition reached him. "—diamond won't scratch it, Shor Nun—more elastic than beryl steel. Tough—"

That was Dee Lun, the metallurgist. He would learn that secret somehow. They would all learn. And Shor Nun, commander, executive, atomic engineer, would learn the secrets that their power plants must hold. The dream—the city's life—would go on!

Ron Thule wandered on. No duty his, to-day, no responsibility to study carefully the form and turn of sweeping line, the hidden art that floated ten millions of tons of mass on the grace of a line. That for the archaeologist and the engineer. Nor his to study the cunning form of brace and girder, the making of the pearly walls. That for metallurgist and chemist.

SEUN was beside him, looking slowly about the great avenues that swept away into slim canyons in the distance.

"Your people visited ours, once," said Ron Thule softly. "There are legends, the golden gods that came to Pareeth, bringing gifts of fire and the bow and the hammer. The myths have endured through two millions of our years—four and a half millions of yours. With fire and bow and hammer my people climbed to civilization. With atomic power they blasted themselves back to the swamps. Four times they climbed, discovered the secret of the atom, and blasted themselves back to the swamps. Yet all the changes could not efface the thankfulness to the golden gods, who came when Pareeth was young."

Seun nodded slowly. His unspoken thoughts formed clear and sharp in the astronomer's mind. "Yes, I know. The city builders, it was. Once, your sun and ours circled in a system as a double star. A wandering star crashed through that system, breaking it, and in the breaking making planets. Your sun circled away, the new-formed planets cooling; our Sun remained, these worlds cooling till the day life appeared. We are twin races, born of the same stellar birth. The

city builders found that, and sought your worlds. They were a hundred thousand light years distant, in that time, across all the width of the galaxy, as the two suns circled in separate orbits about the mass of the galaxy.

"The city builders went to see your race but once; they had meant to return, but before the return was made they had interfered in the history of another race, helping them. For their reward the city builders were attacked by their own weapons, by their own pupils. Never again have we disturbed another race."

"Across the galaxy, though." The Great Year—how could they—so many stars—

"The problem of multiple bodies? The city builders solved it; they traced the orbits of all the suns of all space; they knew then what sun must once have circled with ours. The mathematics of it—I have forgotten—I cannot develop it. I am afraid I cannot answer your thoughts. My people have forgotten so many things the city builders knew.

"But your people seek entrance to the buildings. I know the city, all its ways and entrances. The drifting soil has covered every doorway, save those that once were used for the great airships. They are still unblocked. I know of one at this level, I think. Perhaps—"

## II.

RON THULE walked slowly back toward the group. Seun was speaking with Shor Nun, and now they angled off across the city. Their voices hushed; their footfalls were lost in the silence that brooded forever over the towers. Down timeless avenues they marched, a tiny band in the valley of the Titans. The towers marched on and on, on either side, up over low hills, beyond the horizon. Then, before them, in the side of one of the milky walls a great opening showed. Some five feet above

the level of the drifted soil, it led into the vast, black maw of the building. The little party grouped at the base, then, laboriously, one of the engineers boosted and climbed his way to the threshold and dropped a rope to a companion.

Seun stood a bit apart, till Shor Nun lifted himself up to the higher level and stood on the milky floor. Then the man of Rhth seemed to glow slightly; a golden haze surrounded him and he floated effortlessly up from the ground and into the doorway.

The engineers, Shor Nun, all stood frozen, watching him. Seun stopped, turned, half smiling. "How? It is the *lathan*, the suit I wear."

"It defies gravity?" asked Shor Nun, his dark eyes narrowing in keenest interest.

"Defies gravity? No, it does not defy, for gravity is a natural law. The city builders knew that. They made these suits shortly before they left the city. The *lathan* simply bends gravity to will. The mechanism is in the filaments of the back, servant to a wish. Its operation—I know only vague principles. I—I have forgotten so much. I will try to explain—"

Ron Thule felt the thoughts parading through his mind: Nodes and vibrations, atoms and less than atoms, a strange, invisible fabric of woven strains that were not there. His mind rebelled. Vague, inchoate stirrings of ideas that had no clarity; the thoughts were formless and indistinct, uncertain of themselves. They broke off.

"We have forgotten so much of the things the city builders knew, their arts and techniques," Seun explained. "They built things and labored that things might surround and protect them, as they thought. They labored generations that this city might be. They strove and thought and worked, and built fleets that sailed beyond the farthest star the clearest night reveals. They brought here their gains, their

hard-won treasures—that they might build and make to protect these things.

"They were impermanent things, at best. How little is left of their five-million-year striving. We have no things to-day, nor any protecting of things. And we have forgotten the arts they developed to protect and understand these things. And with them, I am sorry, I have forgotten the thoughts that make the *lathan* understandable."

Shor Nun nodded slowly, turned to his party. Ron Thule looked back from this slight elevation, down the long avenue. And his eyes wandered aside to this descendant of the mighty dreamers, who dreamed no more.

"Seek passages to lower levels," said Shor Nun's voice. "Their records, their main interest must have centered near the ancient ground level. The engineers—we will seek the lowest, subsurface levels, where the powers and the forces of the city must have been generated. Come."

THE opalescent light that filtered through the walls of the building faded to a rose dusk as they burrowed deeper into the vast pile. Corridors branched and turned; rooms and offices dust-littered and barren opened from them. Down the great two-hundred-foot corridor by which they had entered, ships had once floated, and at the heart of the building was a cavernous place where these ships had once rested—and rested still! Great, dim shapes, half seen in the misted light that filtered through wall on translucent wall.

The room blazed suddenly with the white light of half a dozen atomic torches, and the opalescent walls of the room reflected the flare across the flat, dusty sweep of the great floor. Two-score smooth shapes of flowing lines clustered on the floor, a forgotten company of travelers that had stopped here, once; when the city roared in trium-

phant life. A powdery, gray dust covered their crystal hulls.

Slowly, Shor Nun walked toward the nearest of them, a slim, thirty-foot-long private ship, waiting through eternity for a forgotten hand. The open lock at the side lighted suddenly at the touch of his foot, and soft lights appeared throughout the ship. Somewhere a soft, low humming began, and faded into silence in a moment. "Drus Nol—come with me. Seun, do you know the mechanism of these ships?"

The man of Rhth hesitated; then shook his head slowly. "I cannot explain it." He sighed. "They will not function now; they drew their power from the central plant of the city, and that has ceased operation. The last of the city builders shut it down as they left."

The men of Pareeth entered the ship hesitantly, and even while they walked toward the central control cabin at the nose, the white lighting dimmed through yellow, and faded out. Only their own torches remained. The stored power that had lain hidden in some cells aboard this craft was gone in a last, fitful glow. Somewhere soft, muffled thuds of relays acted, switching vainly to seek charged, emergency cells. The lights flared and died, flared and vanished. The questing relays relaxed with a tired click.

Dust-shrouded mechanism, etched in the light of flaring torches, greeted their eyes, hunched bulks, and gleaming tubes of glassy stuff that, by its sparkling, fiery life must be other than any glass they knew, more nearly kin to the brilliant refraction of the diamond.

"The power plant," said Shor Nun softly, "I think we had best look at that first. These are probably decayed; there might still be some stored power in the central plant they could pick up and give us a fatal shock. The insulation here——"

But the city builders had built well.

There was no sign of frayed and age-rotted insulation. Only slight gray dust lay in torn blankets, tender fabric their movements had disturbed.

SEUN walked slowly toward the far end of the room, rounding the silent, lightless bulks of the ancient ships. The dust of forgotten ages stirred softly in his wake, settled behind him. The men of Pareeth gathered in his steps, followed him toward the far wall.

A doorway opened there, and they entered a small room. The archæologist's breath whistled; the four walls were decorated with friezes of the history of the race that had built, conquered and sailed a universe—and lived in domes under sheltering trees.

Seun saw his interest, touched a panel at his side. Soundlessly, a door slid from the wall, clicked softly, and completed the frieze on that wall. The archæologist was sketching swiftly, speaking to the chemist and the photographer as he worked. The torches flared higher for a moment, and the men moved about in the twenty-foot room, making way for the remembering eye of the little camera.

As Seun touched another stud, the door slid back into the wall. The room of the ships was gone. Hastily, the men of Pareeth turned to Seun.

"Will that elevator work safely to raise us again? You said the power was cut off——"

"There is stored power. Nearly all had leaked away, but it was designed to be sufficient to run all this city and all its ships, wherever they might be, for seven days. There is power enough. And there are foot passages if you fear the power will not be sufficient. This is the lowest level; this is the level of the machines, the heart of the city—nearly one thousand feet below the level at which we entered."

"Are the machines, the power plant, in this building?"



"There is only one building, here beneath the ground. It is the city, but it has many heads. The power plant is off here, I think. It has been a long time since I came this way. I was young then, and the city builders fascinated me. Their story is interesting and——"

"Interesting——" The thought seemed to echo in Ron Thule's mind. The story of the conquest of a universe, the story of achievement such as his race dreamed of now. They had dreamed—and done. And that, to their descendants, that was—interesting. Interesting to this dark, strange labyrinth of branching corridors, and strange, hooded bulks. Production machinery, he knew, somehow, production machinery that forgotten workmen had hooded as they stepped away temporarily—for a year or two, perhaps till the waning population should increase again and make new demands on it. Then great storerooms, bundled things that might be needed, spare parts, and stored records and deeds. Libraries of dull metal under gray dust. The unneeded efforts of a thousand generations, rotting in this quiet dark that he, Ron Thule, and his companions had disturbed with the moment's rush of atomic flame.

Then the tortuous corridor branched, joined others, became suddenly a great avenue descending into the power room, the heart of the city and all that it had meant. They waited still, the mighty engines the last of the builders had shut down as he left, waited to start again the work they had dropped for the moment, taking a well-earned rest. But they must have grown tired in that rest, that waiting for the resurgence of their masters. They glowed dimly under the thin blankets of grayed dust, reflecting the clear brilliance of the prying light.

SHOR NUN halted at the gate, his engineer beside him. Slowly, Seun of

Rhth paced into the great chamber. "By the golden gods of Pareeth, Drus Nol, do you see that insulation—those buss-bars!"

"Five million volts, if its no better than we build," the engineer said, "and I suppose they must be busses, though, by the stars of space, they look like columns! They're twenty-five feet through. But, man, man, the generator—for it must be a generator—it's no longer than the busses it energizes."

"When the generator operated," Seun's thoughts came, "the field it created ran through the bars, so that they, too, became nearly perfect conductors. The generator supplied the city, and its ships, wherever in all space they might be." And the further thought came into their minds, "It was the finest thing the city builders had."

Shor Nun stepped over the threshold. His eyes followed the immense busses, across in a great loop to a dimly sparkling switch panel, then across, and down to a thing in the center of the hall, a thing——

Shor Nun cried out, laughed and sobbed all at one moment. His hands clawed at his eyes; he fell to his knees, groaning. "Don't look—by the gods, don't look——" he gasped.

Drus Nol leaped forward, bent at his side. Shor Nun's feet moved in slow arcs through the dust of the floor, and his hands covered his face.

Seun of Rhth stepped over to him with a strange deliberation that yet was speed. "Shor Nun," came his thought, and the man of Pareeth straightened under it, "stand up."

Slowly, like an automaton, the commander of the expedition rose, twitching, his hands falling to his sides. His eyes were blank, white things in their sockets, and horrible to look at.

"Shor Nun, look at me, turn your eyes on me," said Seun. He stood half a head taller than the man of Pareeth, very slim and straight, and his eyes

seemed to glow in the light that surrounded him.

As though pulled by a greater force, Shor Nun's eyes turned slowly, and first their brown edges, then the pupils showed again. The frozen madness in his face relaxed; he slumped softly into a "more natural position—and Seun looked away.

Unsteadily, Shor Nun sat down on a great angling beam. "Don't look for the end of those busses, Drus Nol—it is not good. They knew all the universe, and the ends of it, long before they built this city. The things these men have forgotten embrace all the knowledge our race has, and a thousand thousand times more, and yet they have the ancient characteristics that made certain things possible to the city builders. I do not know what that thing may be, but my eyes had to follow it, and it went into another dimension. Seun, what is that thing?"

"The generator supplied the power for the city, and for the ships of the city, wherever they might be in space. In all the universe they could draw on the power of that generator, through that *sorgan* unit. That was the master unit; from it flowed the power of the generator, instantaneously, to any ship in all space, so long as its corresponding unit was tuned. It created a field rotating"—and the minds of his hearers refused the term—"which involves, as well, time.

"In the first revolution it made, the first day it was built, it circled to the ultimate end of time and the universe, and back to the day it was built. And in all that sweep, every *sorgan* unit tuned to it must follow. The power that drove it died when the city was deserted, but it is still making the first revolution, which it made and completed in the first hundredth of a second it existed.

"Because it circled to the end of time, it passed this moment in its swing, and every other moment that ever is to be.

Were you to wipe it out with your mightiest atomic blast, it would not be disturbed, for it is in the next instant, as it was when it was built. And so it is at the end of time, unchanged. Nothing in space or time can alter that, for it has already been at the end of time. That is why it rotates still, and will rotate when this world dissolves, and the stars die out and scatter as dust in space. Only when the ultimate equality is established, when no more change is, or can be will it be at rest—for then other things will be equal to it, all space equated to it, because space, too, will be unchanged through time.

"Since, in its first swing, it turned to that time, and back to the day it was built, it radiated its power to the end of space and back. Anywhere, it might be drawn on, and was drawn on by the ships that sailed to other stars."

Ron Thule glanced very quickly toward and away from the *sorgan* unit. It rotated motionlessly, twinkling and winking in swift immobility. It was some ten feet in diameter, a round spheroid of rigidly fixed coils that slipped away and away in flashing speed. His eyes twisted and his thoughts seemed to freeze as he looked at it. Then he seemed to see beyond and through it, as though it were an infinite window, to ten thousand other immobile, swiftly spinning coils revolving in perfect harmony, and beyond them to strange stars and worlds beyond the suns—a thousand cities such as this on a thousand planets: the empire of the city builders!

And the dream faded—faded as that dream in stone and crystal and metal, everlasting reality, had faded in the softness of human tissue.

### III.

THE SHIP hung motionless over the towers for a long moment. Sunlight, reddened as the stars sank behind the

far hills, flushed their opalescent beauty with a soft tint, softened even the harsh, utilitarian gray of the great, interstellar cruiser above them into an idle, rosy dream. A dream, perhaps, such as the towers had dreamed ten thousand times ten thousand times these long æons they had waited?

Ron Thule looked down at them, and a feeling of satisfaction and fulfillment came to him. Pareeth would send her children. A colony here, on this ancient world would bring a new, stronger blood to wash up in a great tide, to carry the ideals this race had forgotten to new heights, new achievements. Over the low hills, visible from this elevation, lay the simple, rounded domes of the people of Rhth—Seun and his little clan of half a hundred—the dwindling representatives of a once-great race.

It would mean death to these people—these last descendants. A new world, busy with a great work of reconquering this system, then all space! They would have no time to protect and care for these forgetful ones; these people of Rhth inevitably would dwindle swiftly in a strange, busy world. They who had forgotten progress five millions of years before; they who had been untrue to the dream of the city builders.

It was for Pareeth, and the sons of Pareeth to carry on the abandoned path again—

CONCLUSION OF THE REPORT  
TO THE COMMITTEE OF  
PARÉETH  
SUBMITTED BY SHOR NUN,  
COMMANDER OF THE FIRST  
INTERSTELLAR EXPEDITION

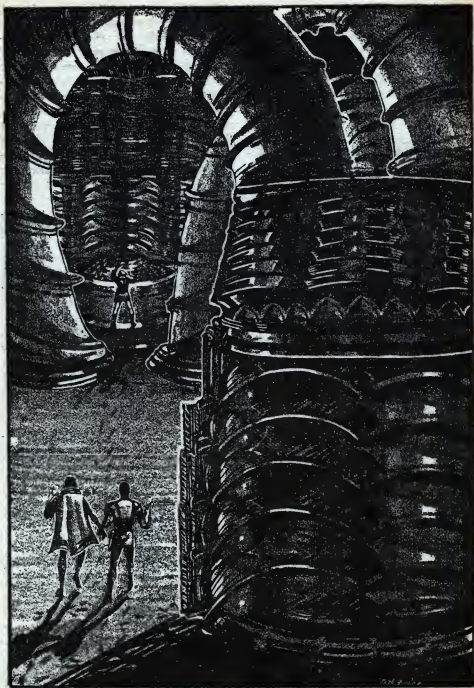
—thus it seemed wise to me that we leave at the end of a single week, despite the objections of those members of the expedition personnel who had had no opportunity to see this world. It was better not to disturb the decadent inhabitants of Rhth in any further degree,

and better that we return to Pareeth with these reports as soon as might be, since building operations would soon commence on the twelve new ships.

I suggest that these new ships be built of the new material *rhthite*, superior to our best previous materials. As has been shown by the incredible endurance of the buildings of the city, this material is exceedingly stable, and we have found it may be synthesized from the cheapest materials, saving many millions in the construction work to be undertaken.

It has been suggested by a certain member of the expedition, notable Thon Raul, the anthropologist, that we may underestimate the degree of civilization actually retained by the people of Rhth, specifically that it is possible that a type of civilization exists so radically divergent from our own, that it is to us unrecognizable as civilization. His suggestion of a purely mental civilization of a high order seems untenable in the face of the fact that Seun, a man well respected by his fellows, was unable to project his thoughts clearly at any time, nor was there any evidence that any large proportion of his thoughts were to himself of a high order of clarity. His answers were typified by "I have forgotten the development—" or "It is difficult for me to explain—" or "The exact mechanism is not understood by all of us—a few historians—"

It is, of course, impossible to disprove the assertion that such a civilization is possible, but there arises in my mind the question of advantage gained, it being a maxim of any evolutionary or advancing process that the change so made is, in some manner, beneficial to the modified organism of society. Evidently, on the statements made by Seun of Rhth, they have forgotten the knowledge once held by the mighty race that built the cities, and have receded to a state of repose without labor or progress of any kind.



*"Don't look for the end of those busses, Drus Nol—it is not good. I don't know what that thing may be, but my eyes had to follow it—and it went into another dimension——"*

Thon Raul has mentioned the effect produced on me by close observation of the *sorgan* mechanism, and further stated that Seun was able to watch this same mechanism without trouble, and able to benefit me after my unfortunate experience. I would point out that mental potentialities decline extremely slowly; it is possible that the present, decadent people have the mental potentialities, still inherent in them, that permitted the immense civilization of the city builders.

It lies there, dormant. They are lost for lack of the driving will that makes it effective. The *Pareeth*, the greatest ship our race has ever built, is powered, fueled, potentially mighty now—and inert for lack of a man's driving will, since no one is at her helm.

So it is with them. Still, the mental capacity of the race overshadows us. But the divine fire of ambition has died. They rely wholly on materials and tools given them by a long-dead people, using even these in an automatic and uncomprehending way, as they do their curious flying suits.

Finally, it is our conclusion that the twelve ships under consideration should be completed with all possible speed, and the program as at present outlined carried out in full; *i. e.* seven thousand, six hundred and thirty-eight men and women between the ages of eighteen and twenty-eight will be selected on a basis of health, previous family history, personal character and ability as determined by psychological tests. These will be transported, together with a basic list of necessities, to the new planet, leaving in the early months of the coming year.

Six years will be required for this trip. At the end of the first year on the new planet, when some degree of organization has been attained, one ship, refueled, will return to *Pareeth*. At the end of the second year two ships will return from *Rhth* with all data ac-

cumulated in that period. Thereafter, two will sail each year.

On *Pareeth*, new ships will be manufactured at whatever rate seems practicable, that more colonists may be sent as swiftly as they desire. It is suggested, however, that, in view of the immense scientific advancements already seen in the cities of *Rhth*, no new ships be made until a ship returns with the reports of the first year's studies, in order that any resultant scientific advances may be incorporated.

The present crew of the *Pareeth* have proven themselves in every way competent, courageous and coöperative. As trained and experienced interstellar operators, it is further suggested that the one hundred men be divided among the thirteen ships to sail, the *Pareeth* retaining at least fifty of her present crew and acting as guide to the remainder of the fleet. Ron Thule, it is specifically requested, shall be astronomical commander of the fleet aboard the flagship. His astronomical work in positioning and calculating the new system has been of the highest order, and his presence is vitally needed.

Signed by me, SHOR NUN,  
this thirty-second day after landing.

#### UNANIMOUS REPORT OF THE COMMITTEE OF PAREETH ON THE FIRST EXPEDITION TO THE PLANET RHTH

The Committee of *Pareeth*, after due consideration of the reports of Folder RI27-s6-II, entitled "Interstellar Exploration Reports, Expedition I" do send to commander of said expedition, Shor Nun, greetings.

The committee finds the reports highly satisfying, both in view of the successful nature of the expedition, and in that they represent an almost unanimous opinion.

In consequence, it is ordered that the



ships designated by the department of engineering plan as numbers 18834-18846 be constructed with such expedition as is possible.

It is ordered that the seven thousand six hundred and thirty-eight young people be chosen in the manner prescribed in the attached docket of details.

It is ordered that in the event of the successful termination of the new colonizing expedition, such arrangements shall be made that the present, decadent inhabitants of the planet Rhth shall be allowed free and plentiful land; that they shall be in no way molested or attacked. It is the policy of this committee of Pareeth that this race shall be wards of the newly founded Rhth State, to be protected and in all ways aided in their life.

We feel, further, a deep obligation to this race in that the archaeologist and anthropological reports clearly indicate that it was the race known to them as the city builders who first brought fire, the bow and the hammer to our race in mythological times. Once their race gave ours a foothold on the climb to civilization. It is our firm policy that these last, decadent members of that great race shall be given all protection, assistance and encouragement possible to tread again the climbing path.

It is ordered that the first colony city on Rhth shall be established at the spot represented on the accompanying maps as N'yor, as called in the language of the Rhth people, near the point of landing of the first expedition. The near-by settlement of the Rhth people is not to be molested in any way, unless military action is forced upon the colonists.

It is ordered that if this condition shall arise, if the Rhth people object to the proposed settlement at the spot designated as N'yor, arbitration be attempted. Should this measure prove unsuccessful, military penalties shall be exacted, but only to the extent found

necessary for effective action. The colonists shall aid in the moving of the settlement of the Rhth people, if the Rhth people do not desire to be near the city of the colonists.

In any case, it is ordered that the colonists shall, in every way within their aid, advance and inspire the remaining people of Rhth.

It is further ordered that Shor Nun, commander, shall be plenipotentiary representative of the committee of Pareeth, with all powers of a discretionary nature, his command to be military and of unquestioned authority until such time as the colony shall have been established for a period of two years. There shall then have been established a representative government of such nature and powers as the colonists themselves find suitable.

It is then suggested that this government, the State of Rhth, shall exchange such representatives with the committee of Pareeth as are suitable in the dealings of two sovereign powers.

Until the establishment of the State of Rhth, it is further ordered that—

#### IV.

THE GRASSLAND rolled away very softly among the brown boles of scattered trees. It seemed unchanged. The city seemed unchanged, floating as it had a thousand thousand years half-way between the blue of the sky and the green of the planet. Only it was not alone in its opalescent beauty now; twelve great ships floated serene, motionless, above its towers, matching them in glowing color. And on the low roll of the hill, a thirteenth ship, gray and grim and scarred with eighteen years of nearly continuous space travel, rested. The locks moved; men stepped forth into the light of the low, afternoon sun.

To their right, the mighty monument of the city builders; to their left, the low, rounded domes of the great race's de-

scendants. Ron Thule stepped down from the lock to join the eight, department commanders who stood looking across toward the village among the trees.

Shor Nun turned slowly to the men with him, shook his head, smiling. "I did not think to ask. I have no idea what their life span may be. Perhaps the man we knew as Seun has died. When I first landed here, I was a young man. I am middle-aged now. That time may mean old age and extinction to these people."

"There is one man coming toward us now, Shor Nun," said Ron Thule softly. "He is floating on his—what was that name?—it is a long time since I heard it."

The man came nearer leisurely; time seemed to mean little to these people. The soft, blue glow of his suit grew, and he moved a bit more rapidly, as though conscious of their importance. "I—I think that is Seun," said the archaeologist. "I have seen those pictures so many times—"

Seun stood before them again, smiling the slow, easy smile they had known twelve years before. Still he stood slim and straight, his face lined only with the easy gravings of humor and kindness. He was as unchanged as the grassland, as the eternal city. The glow faded as he settled before them, noiselessly. "You have come back to Rhth, Shor Nun?"

"Yes, Seun. We promised you that when we left. And with some of our people as well. We hope to establish a colony here, near the ancient city; hope some day to learn again the secrets of the city builders, to roam space as they once did. Perhaps we will be able to occupy some of the long-deserted buildings of the city and bring life to it again."

"A permanent colony?" asked Seun thoughtfully.

"Yes, Seun."

"There are many other cities here, on

this planet, nearly as large, equipped with all the things that made this city. To my race the quiet of the unstirred air is very dear; could you not as easily establish your colony in Shao—or Loun—any of the other places?"

Shor Nun shook his head slowly. "I am sorry, Seun. We had hoped to live near you, that we might both discover again those forgotten secrets. We must stay here, for this was the last city your people deserted; here in it are all the things they ever built, the last achievements of the city builders. We will aid you in moving your colony if you wish, to some other meadowland near the sea. All the world is the same to your people; only this city was built in this way; it was the last to be deserted."

SEUN exhaled softly, looked at the ten men of Pareeth. His mind seemed groping, feeling for something. His deep blue eyes misted in thought, then cleared slowly as Ron Thule watched. Slowly, they moved from man to man of the group, pausing a moment at the anthropologist, catching Shor Nun's gaze for an instant, centering slowly on Ron Thule.

Ron Thule looked into the deep eyes for a moment, for a long eternity—deep, clear eyes, like mountain lakes. Subtly, the Rhthman's face seemed to change as he watched the eyes. The languor there changed, became a sense of timelessness, of limitlessness. The pleasant, carefree air became, somehow—different. It was the same, but as the astronomer looked into those eyes, a new interpretation came to him. A sudden, vast fear welled up in him, so that his heart contracted, and a sudden tremor came to his hands. "You have forgotten—" he mumbled unsteadily. "Yes—but you—"

Seun smiled, the firm mouth relaxing in approval. "Yes, Ron Thule. That is enough. I sought your mind. Some one must understand. Remember that

only twice in the history of our race have we attempted to alter the course of another's history, for by that you will understand what I must do."

Seun's eyes turned away. Shor Nun was looking at him, and Ron Thule realized, without quite understanding his knowledge, that no time had elapsed for these others. Now he stood motionless, paralyzed with a new understanding.

"We must stay here," Seun's mind voice spoke softly. "I, too, had hoped we might live on this world together, but we are too different. We are too far apart to be so near."

"You do not wish to move?" asked Shor Nun sorrowfully.

Seun looked up. The twelve great interstellar cruisers hovered closer now, forming, almost, a roof over this conference ground. "That would be for the council to say, I know. But I think they would agree with me, Shor Nun."

Vague pictures and ideas moved through their minds, thoughts emanating from Seun's mind. Slowly, his eyes dropped from the twelve opalescent cruisers to the outstretched palm of his hand. His eyes grew bright, and the lines of his face deepened in concentration. The air seemed to stir and move; a tenseness of inaction came over the ten men of Pareeth and they moved restlessly.

QUITE ABRUPTLY, a dazzling light appeared over Seun's hand, sparkling, myriad colors—and died with a tiny, crystalline clatter. Something lay in his upturned palm: a round, small thing of aquamarine crystal, shot through with veins and arteries of softly pulsing, silver light. It moved and altered as they watched, fading in color, changing the form and outline of light.

Again the tinkling, crystalline clatter came, and some rearrangement had taken place. There lay in his hand a tiny globe of ultimate night, an essence of darkness that no light could illumine,

cased in a crystal surface. Stars shone in it, from the heart, from the borders, stars that moved and turned in majestic splendor in infinite smallness. Then faded.

Seun raised his eyes. The darkness faded from the crystal in his hand, and pulsing, little veins of light appeared in it. He raised it in his fingers, and nine of Pareeth's men fell back. Ron Thule looked on with frozen, wooden face.

A wave of blue haze washed out, caught and lifted the men and carried them effortlessly, intangibly back to the lock, through the lock. From the quiet of the grassland they were suddenly in the steel of the ship that clanged and howled with alarms. Great engines belated suddenly to life.

Ron Thule stood at the great, clear port light of the lock. Outside, Seun, in his softly glowing suit, floated a few feet from the ground. Abruptly, the great atomic engines of the *Pareeth* shrilled a chorus of ravening hate, and from the three great projectors the annihilating beams tore out, shrieking destruction through the air—and vanished. Seun stood at the junction of death, and his crystal glowed softly. Twelve floating ships screamed to the tortured shriek of overloaded atomics, and the planet below cursed back with quarter-mile-long tongues of lightning.

Somewhere, everywhere, the universe thrummed to a vast, crystalline note, and hummed softly. In that instant, the green meadowland of Rhth vanished; the eternal city dissolved into blackness. Only blackness, starless, lightless shone outside the lock port light. The soft, clear note of the crystal hummed and beat and surged. The atomic engine's cry died full-throated. An utter, paralyzed quiet descended on the ship, so that the cry of a child somewhere echoed and reverberated noisily down the steel corridors.

The crystal in Seun's hand beat and hummed its note. The blackness beyond

the port became gray. One by one, six opalescent ships shifted into view in the blackness beyond, moving with a slow deliberation, as though forced by some infinite power into a certain, predetermined configuration. Like atoms in a crystal lattice they shifted, seemed to click into place and hold steady—neatly, geometrically arranged.

THEN NOISE came back to the ship, sounds that crept in, afraid of themselves, grew courageous and clamored; pounding feet of men, and women's screams.

"We're out of space," gasped Shor Nun. "That crystal—that thing in his hand——"

"In a space of our own," said Ron Thule. "Wait till the note of the crystal dies down. It is weakening, weakening slowly, to us, but it will be gone, and then——"

Shor Nun turned to him, his dark eyes shadowed, his face pale, and drawn. "What do you know—how——"

Ron Thule stood silent. He did not know. Somewhere, a crystal echoed for a moment in rearrangement and tinkling sound; the universe echoed to it softly, as the last, faint tone died away.

"Shor Nun—Shor Nun——" a slow, wailing cry was building up in the ship. Scampering feet on metal floors became a march.

Shor Nun sobbed once. "That crystal—they had not lost the weapons of the city builders. Space of our own? No—it is like the *sorgan*: It rotates us to the end of time! This is the space we knew—when all time has died, and the stars are gone and the worlds are dust. This is the end of the nothingness. The city builders destroyed their enemies thus—by dumping them at the end of time and space. I know. They must have. And Seun had the ancient weapon. When the humming note of the crystal dies—the lingering force of translation——

"Then we shall die, too. Die in the

death of death. Oh, gods—Sulon—Sulon, my dear—our son——" Shor Nun, commander, seemed to slump from his frozen rigidity. He turned abruptly away from the port light toward the inner lock door. It opened before him suddenly, and a technician stumbled down, white-faced and trembling.

"Commander—Shor Nun—the engines are stopped. The atoms will not explode; no power can be generated. The power cells are supplying emergency power, but the full strength of the drive does not move nor shake the ship! What—what is this?"

Shor Nun stood silent. The ship thrummed and beat with the softening, dying note of the universe-distant crystal that held all the beginnings and the endings of time and space in a man's hand. The note was fading; very soft and sweet, it was. Through the ship the hysterical cry of voices had changed; it was softening with the thrum, softening, listening to the dying thread of infinitely sweet sound.

Shor Nun shrugged his shoulders, turned away. "It does not matter. The force is fading. Across ten million years the city buildings have reached to protect their descendants."

The note was very low—very faint; a quivering hush bound the ship. Beyond the port light, the six sister ships began to move again, very stealthily away, retreating toward the positions they had held when this force first seized them. Then——

Shor Nun's choked cry was drowned in the cries of the others in the lock. Blinding white light stabbed through the port like a solid, incandescent bar. Their eyes were hot and burning.

Ron Thule, his astronomer's eyes accustomed to rapid, extreme changes of light, recovered first. His word was indistinct, a cross between a sob and a chuckle.

Shor Nun stood beside him, winking

tortured eyes. The ship was waking, howling into a mad, frightened life; the children screamed in sympathetic comprehension of their elders' terror.

White, blazing sunlight on green grass and brown dirt. The weathered gray of concrete, and the angular harshness of great building cradles. A sky line of white-tipped, blue mountains, broken by nearer, less-majestic structures of steel and stone and glass, glinting in the rays of a strong, warm sun with a commonness, a familiarity that hurt. A vast nostalgia welled up in them at the sight—

And died before another wave of terror. "Darun Tara," said Shor Nun. "Darun Tara, on Pareeth. I am mad—this is mad. A crazy vision in a crazy instant as the translating force collapses. Darun Tara as it was when we left it six long years ago. Changed—that half-finished shed is still only three quarters finished. I can see Thio Roul, the portmaster there, coming toward us. I am mad. I am five light years away—"

"It is Darun Tara, Shor Nun," Ron Thule whispered. "And the city builders could never have done this. I understand now. I—"

He stopped. The whole, great ship vibrated suddenly to thwang like the plucked, bass string of a Titan's harp. Creaks and squeals, and little grunting readjustments, the fabric of the cruiser protested.

"My telescope—" cried Ron Thule. He was running toward the inner lock door, into the dark mouth of the corridor.

Again the ship thrummed to a vibrant stroke. The creaking of the girders and strakes protested bitterly; stressed rivets grunted angrily.

Men pounded on the lock door from without. Thio Raul, Ton Gareth, Hol Brawn—familiar faces staring anxiously in. Shor Nun moved dully toward the gate controls—

## V.

SHOR NUN knocked gently at the closed, metal door of the ship's observatory. Ron Thule's voice answered, muffled, vague, from beyond.

The commander opened the door; his breath sucked in sibilantly. "Space!" he gasped.

"Come and see, come and see," the astronomer called softly.

Shor Nun instinctively felt his way forward on tiptoe. The great observatory room was space; it was utter blackness, and the corridor lights were swallowed in it the instant the man crossed the threshold. Blackness, starred by tiny, brilliant points, scattered very sparsely, in every direction.

"Seun took the telescope, but he left me this, instead. I understand now; he said that only twice had they attempted to alter a race's history.

"This is space, and *that* is Troth, our own star. Watch—"

The star expanded; the whole of this imageless space exploded outward and vanished through the unseen walls of the observatory. Troth floated alone, centered in the invisible room. Seven, tiny dots of light hung near it, glowing in its reflected light.

"And that is our system. Now this is the star of Rhth—"

Space contracted, shifted and exploded, leaving one shining, yellowish star, attended by five brightly visible worlds.

"The other planets are too small or too dimly illumined to see. When I came there was a new system displayed. This one."

Another planetary system appeared. "That is the system of Prothor."

"Prother!" Shor Nun stared. "Five and a half light years away—and planets?"

"Planets. Uninhabited, for I can bring each planet as near as I will. But, Shor Nun"—sorrow crept into the



astronomer's voice—"though I can see every detail of each planet of that system, though I can see each outline of the planets of Rhth's system—only those three stars can I see, close by."

"No other planetary systems!"

"No other planetary system that Seun will reveal to us. I understand. One we won on the right of our own minds, our own knowledge; we reached his worlds. We had won a secret from nature by our own powers; it was part of the history of our race. They do not want to molest, or in any way influence the history of a race—so they permitted us to return, if only we did not disturb them. They could not refuse us that, a breach in their feelings of justice.

"BUT they felt it needful to dispossess us, Shor Nun, and this Seun did. But had he done no more, our history was altered, changed vitally. So—this he gave us; he has shown us another, equally near planetary system that we may use. We have not lost vitally. That is his justice."

"His justice. Yes, I came to you, Ron Thule, because you seemed to know somewhat of the things that happened." Shor Nun's voice was low in the dark of the observatory. He looked at the floating planets of Prothor. "What is—Seun? How has this happened? Do you know? You know that we were greeted by our friends—and they turned away from us.

"Six years have passed for us. They wanted to know what misfortune made us return at the end—of a single year. One year has passed here on Pareeth. My son was born, there in space, and he has passed his fourth birthday. My daughter is two. Yet these things have not happened, for we were gone a single year. Seun has done it, but it cannot be; Seun, the decadent son of the city builders; Seun, who has forgotten the secrets of the ships that sailed beyond the stars and the building of the Titan

Towers, opalescent in the sun; Seun, whose people live in a tiny village sheltered from the rains and the sun by a few green trees.

"What are these people of Rhth?"

Ron Thule's voice was a whisper from the darkness. "I come from a far world, by what strange freak we will not say. I am a savage, a rising race that has not learned the secret of fire, nor bow, nor hammer. Tell me, Shor Nun, what is the nature of the two dry sticks I must rub, that fire may be born? Must they be hard, tough oak, or should one be a soft, resinous bit of pine? Tell me how I may make fire."

"Why—with matches or a heat ra— No, Ron Thule. Vague thoughts, meaningless ideas and unclear. I—I have forgotten the ten thousand generations of development. I cannot retreat to a level you, savage of an untrained world, would understand. I—I have forgotten."

"Then tell me, how I must hold the flint, and where must I press with a bit of deer horn that the chips shall fly small and even, so that the knife will be sharp and kill my prey for me? And how shall I rub and wash and treat the wood of the bow, or the skin of the slain animal that I may have a coat that will not be stiff, but soft and pliable?"

"Those, too, I have forgotten. Those are unnecessary things. I cannot help you, savage. I would greet you, and show you the relics of our deserted past in museums. I might conduct you through ancient caves, where mighty rock walls defended my ancestors against the wild things they could not control.

"Yes, Ron Thule. I have forgotten the development."

"ONCE"—Ron Thule's voice was tense—"the city builder made atomic generators to release the energy bound in that violent twist of space called an atom. He made the *sorgano* to distribute

its power to his clumsy shells of metal and crystal—the caves that protected him from the wild things of space.

"Seun has forgotten the atom; he thinks in terms of space. The powers of space are at his direct command. He created the crystal that brought us here from the energy of space, because it made easy a task his mind alone could have done. It was no more needful than is an adding machine. His people have no ships; they are anywhere in space they will without such things. Seun is not a decadent son of the city builders. His people never forgot the dream that built the city. But it was a dream of childhood, and his people were children then. Like a child with his broomstick horse, the mind alone was not enough for thought; the city builders, just as ourselves, needed something of a solid metal and crystal, to make their dreams tangible."

"My son was born in space, and is four. Yet we were gone a single year from Pareeth." Shor Nun sighed.

"Our fleet took six years to cross the gulf of five light years. In thirty seconds, infinitely faster than light, Seun returned us, that there might be the minimum change in our racial history. Time is a function of the velocity of light, and five light years of distance is precisely equal to five years of time multiplied by the square root of minus one. When we traversed five light years

of space in no appreciable time, we dropped back, also, through five years of time.

"You and I have spent eighteen years of effort in this exploration, Shor Nun—eighteen years of our manhood. By this hurling us back Seun has forever denied us the planets we earned by those long years of effort. But now he does not deny us wholly.

"They gave us this, and by it another sun, with other planets. This Seun gave not to me, as an astronomer; it is his gift to the race. Now it is beyond us ever to make another. And this which projects this space around us will cease to be, I think, on the day we land on those other planets of that other sun, where Seun will be to watch us—as he may be here now, to see that we understand his meanings.

"I know only this—that sun I can see, and the planets circling it. The sun of Rhth I can see, and those planets, and our own. But—though these others came so near at the impulse of my thoughts, no other sun in all space can I see so near.

"That, I think, is the wish of Seun and his race."

The astronomer stiffened suddenly.

Shor Nun stood straight and tense.

"Yes," whispered Seun, very softly, in their minds.

Ron Thule sighed.



# Reverse Phylogeny

*The awakening of racial memory—for the  
sake of science.*

by A. R. Long

ONCE MORE I have before me the task of explaining to the public another of the escapades of my friend, Professor Aloysius O'Flannigan. Not that Aloysius has asked me to do so; he is far too proud for that. But when—because of a minor incident that had no place in his original plan, and for which he can in no way be held responsible—remarks are made that the whole experiment concerning the lost continent of Atlantis had a decidedly fishy flavor, and when certain malicious-tongued individuals begin to accuse an inoffensive, peace-loving man like Aloysius of deliberately attempting to drown Mr. Theophilus Black on dry land, it seems to me that in mere fairness something ought to be done about it.

It all began with a series of articles of a well-known science magazine, of which Aloysius is an ardent reader. Dropping into his library one day, I found him sitting cross-legged upon the floor, with several copies of the magazine strewn around him. As I entered, he glanced up, made a dive for one of the magazines, and thrust it at me.

"Eric, I want you to read this!" he exclaimed, his eyes gleaming behind his thick-lensed spectacles. "Then tell me what you think of it."

He had turned the magazine open at an article entitled: "Atlantis; Proof of Its Existence," written by a Mr. Theophilus Black. It was a well-constructed article, exhibiting excellent

imaginative qualities and, to my mind at least, quite a bit of erudition on the part of its author. As I finished it and was about to comment, Aloysius pushed a second magazine into my hand.

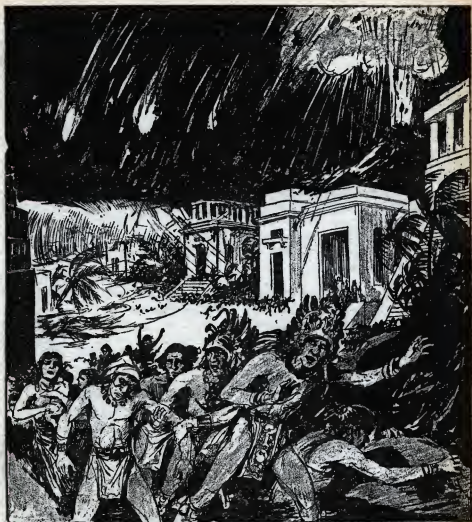
"Read this before you say anything," he directed. "Then give me your reaction to both of them."

The article in the second magazine was called, "Atlantis Debunked"; and it lived up to its title. I read it as Aloysius directed; and, whereas only a few minutes before, Mr. Black had had me ready to swallow the whole continent of Atlantis, Mr. Kenneth McScribe, the author of the second article, now had me gagging on the first pebble. I looked helplessly at Aloysius, feeling a trifle groggy.

"There are several other articles here, but you needn't go into them," he said understandingly. "But what do you think of the Atlantis theory as a whole?"

"I hardly know," I answered, trying to sort out my jumbled reactions. "There seem to be equally good arguments on both sides."

"That's what I felt, too." He nodded. "Mr. Black's logic is excellent; but he builds it upon a rather porous situation, upon which Mr. McScribe has very cleverly turned a microscope. But, in his enthusiasm, Mr. McScribe has used too powerful a lens, and blurred matters a little. For example"—he picked up one of the magazines and selected a particular paragraph—"Mr. McScribe would throw out the evidence



*"The sky is dark with the ashes from volcanoes— The city is being destroyed by earthquakes—"*

of the air-cooled volcanic rocks found in the Atlantic Ocean because Mr. Black cannot quote their geological age. I fail to see where their age has a great deal to do with it. After all, the question is not *when* Atlantis might have existed, but *whether* it existed at any time."

"True," I agreed hopefully. "And the very existence of those rocks is a strong indication——"

"Not so fast!" he broke in. "The existence of those rocks need indicate nothing more than a now-submerged island; and it's going a little strong to construct a whole continent out of that—a little like making a mountain out of a molehill, on an exalted scale."

"You have the darndest way of switching from one side of a question to another!" I complained. "A fellow can't tell whether you actually turn the

corners, or just wander in a circle."

"I'm afraid you haven't got the scientific mind, Eric." He sighed. "What I'm trying to do is sift the evidence."

"And what have you found so far?" I inquired with a touch of sarcasm.

"Not much, I'm afraid," he admitted. "You see, both Mr. Black and Mr. McScribe have made the same error of arguing over material evidence; such things as similarity of place names on both sides of the Atlantic, prehistoric remains, social development, and the like. They should look for psychological indications; racial characteristics or instincts in man himself that would either prove or disprove his descent from inhabitants of a continent——"

HE BROKE OFF in mid-sentence, and a rapt expression came over his face. "Divil an' all!" he exclaimed, slapping his right fist into the palm of his left hand. "I believe it could be done; I'm going to try it!"

"Now what?" I asked a little fearfully, knowing from past experience that when Aloysius used that tone anything might be expected to happen.

"I'm going to awaken racial memory," he replied. "After all, our so-called instincts are nothing more than inherited race memory, as any psychologist will tell you. If those dormant memories can be aroused, brought up from the unconscious into the conscious mind and——"

"But how can it be done?" I wanted to know.

"Through hypnotism, of course," he answered. "I could turn the mind of a subject back through the deep strata of instinct bequeathed to him by his ancestors, inducing him to relive them as if they were a part of his own experience, until we had discovered whether there was or was not an Atlantean layer. Why, we might even settle the mooted question of whether mental traits can be inherited!"

There are times, I reflected, when nothing else in the English language is so expressive as the single word, "Nuts." But I said nothing, hoping that he would work off his enthusiasm by writing a letter to the magazine. I should have known better.

It was only a week later that he sent for me to come around again. Upon arriving at his house, I found that he already had three other guests; two very scholarly-looking gentlemen and a full-blooded Indian, feathers and all.

"Eric," he said, "I want you to meet Mr. Black, Mr. McScribe, and Chief Rain-in-the-Face. Gentlemen, my friend and sometimes colleague, Mr. Dale."

Mr. Black and Mr. McScribe acknowledged the introduction with the usual polite phrases.

Chief Rain-in-the-Face (ah! the appropriateness of that name!) confined himself to a noncommittal, "Ugh."

As for me, I'm afraid I let my jaw fall open rather foolishly.

"I wrote to Mr. Black and Mr. McScribe about my planned experiment to settle the Atlantis question," Aloysius went on, "and they very graciously consented to act as subjects. The fact that they are on opposite sides in the debate will give added significance to our findings."

"I see," I managed a trifle weakly. "And where does—er—Chief Rain-in-the-Face come in?"

"In order to prove or disprove Mr. Black's contention that the first settlers on the American continent were from Atlantis, it was necessary that a genuine Indian take part in the experiment," he explained. "Of course, in order to be really scientific, we should have an Egyptian as well; but none was procurable. However, Mr. Black is convinced that his earliest forbears were Atlanteans; so that will have to suffice.

"And now, gentlemen," he continued, "if you are ready, we will begin the



first step. Eric, you will act as witness and recording secretary."

He lined his subjects up in chairs facing him, and, after a few minutes, succeeded in placing all three of them in a state of deep hypnosis. He then undertook, by suggestion, to turn their minds backward through the layers of inherited instinct, making them relive their "race memories," as he called them, as actual experiences.

I will say this much for what followed: It was extremely interesting, and would have convinced the Reincarnationists that their day of justification had arrived. During the next two hours, Chief Rain-in-the-Face told us all about what had happened to Henry Hudson after he had sailed on his last voyage up the river that now bears his name; while Mr. Black and Mr. McScribe furnished us with some interesting sidelights in the lives of several prominent personages at the courts of Louis XIV and Henry VIII respectively. All in all, it was a morning well spent.

UPON being awakened, none of the three men retained any memory of their mental experiences while in the hypnotic state; and they were exceedingly surprised when I read my notes to them. At Aloysius' request, they all promised to return the next day, when the experiment would be continued.

"Of course, to-day was only the beginning," Aloysius said when we were alone. "A mere scratching of the surface. To-morrow we will go deeper, and the next day deeper still, until, eventually, we reach the level that will prove conclusively from what source these races have sprung."

"I hope you're not claiming that to-day's performance had anything to do with instinct," I remarked. "Why, the very latest of our instincts was developed long before the sixteenth and seventeenth centuries. Moreover, accord-

ing to your own statement, instinct is *race* memory. What these men related to-day were the experiences of single individuals."

"I know that," he admitted unperturbed. "But it only goes to verify another theory of mine. For a long time I have believed that the life experiences of our not-too-distant ancestors are inherited in certain cells of the brain, just as their physical characteristics are duplicated in our bodies. They bear the same relationship to racial memory that family resemblance bears to racial resemblance. For example it——"

"Never mind the example," I cut in. "I'll probably understand better without it. And now, if I may speak figuratively, how long in this experiment of yours before we get through the topsoil and strike bed rock?"

"Oh, about two weeks," he replied. "Incidentally, I like your metaphor. It has such a—er—archæological flavor."

I will not go into a detailed account of all the subsequent steps in the experiment, but will note only the highlights. There was, for instance, the time when Chief Rain-in-the-Face went on the warpath, and attempted to translate his mental experience into physical action with the aid of the table lamp and a letter opener. He entirely wrecked the experiment for that day, and had to be brought out of his hypnotic trance by the somewhat crude means of a crack over the head with a volume of the encyclopedia.

Then there was the time when Mr. McScribe thought he was with Joshua before the walls of Jericho, and insisted upon going out and marching around the block until the policeman on the beat picked him up as a suspicious character.

It was this incident, together with the explanation it entailed, that was responsible for bringing the whole affair to the attention of the public. When we went

to the police station to collect Mr. McScribe, an overenterprising reporter was present; and that evening the story, embellished with lurid details, appeared in his paper. The result was that the next morning representatives of every newspaper in the city descended upon us.

Now Aloysius is retiring by nature, and at first he refused to have anything to do with them. But it is easier to rid oneself of dandruff than of the gentlemen of the press. By sheer persistence, they wore him down, until at last he consented to their being present at the next experiment.

By this time he had got back to the early Egyptian period, and had actually begun to accomplish things with race memory. The reporters were duly impressed; and when their stories appeared, the reading public got its money's worth. Interest in the subject became so acute that the editor of the paper which carried the first story got the brilliant idea that the remainder of the experiment be put on in a public auditorium, the affair to be sponsored by his newspaper.

Naturally, Aloysius would have refused anything so spectacular, had not both Mr. Black and Mr. McScribe intervened. What weight, they argued, would our findings carry if they could be attested to by only one or two men? For the sake of science, the final steps should be taken before a sufficient number of witnesses, so that the outcome could never be doubted. The argument undeniably had its points; and at last, in spite of his better judgment, Aloysius gave in.

It was arranged for the final stage of the experiment to be conducted in the city's largest auditorium. Free tickets could be had by taking a year's subscription to the sponsoring newspaper; and the public's response would have turned Barnum green with envy. Within three days every seat in the house had been taken; and tickets for

standing room were being issued on six months' subscriptions.

AT LAST the fatal night came, when, according to the best calculations, the Atlantean strata in the unconscious minds of the three subjects should be reached. Aloysius had planned to skip a few thousand years in order to get, if possible, a description of Atlantis in its heyday; then to work up gradually to the great inundation. It would, he explained, make the experiment more understandable to the audience.

I think that, of the two of us, I was the more nervous. Experience had taught me that Aloysius' experiments quite frequently ended in unforeseen results; and I did not relish the thought of how so large an audience might react in such a case. I even urged him to have a sort of dress rehearsal in private; but he refused.

"No, Eric," he said firmly. "If I did that, to-night's performance would not be a true experiment, but merely a demonstration of something already proven. I am a man of my word, and must give these people what I promised."

"But suppose there was no continent of Atlantis," I argued. "Then what?"

"In that case," he replied, unruffled, "we will have proven Mr. McScribe's contention."

I saw that there was nothing I could do, so I gave up.

Promptly at eight o'clock, Aloysius stepped out upon the stage, and explained to a packed and eager house what he proposed to do. He was followed by Mr. Black and Mr. McScribe, who, in turn, stated their positions in the matter.

Chief Rain-in-the-Face, upon being introduced next, confined himself to the usual, noncommittal, "Ugh"; since the purpose of the whole affair was still a little hazy in his mind.

Amid a silence heavy enough to be weighed, Aloysius proceeded to place

his three subjects in a state of hypnosis. He had explained that the best results might be expected from Mr. Black; since he alone, once the mental transfer to the remote past had been made, seemed able to translate his awakened race memories into the language of the present. Chief Rain-in-the-Face, when under the hypnotic influence, spoke his native Indian language; while on the last two occasions, Mr. McScribe had emitted only a kind of unintelligible jabbering suggestive of an anthropoid ape.

As soon as the hypnotic trance was deep enough, Aloysius addressed the three collectively, informing them that they were now living before the dawn of recorded history, in approximately the year 20,000 B. C., and directing them to describe their experiences. There followed a minute of tense expectancy, during which a subtle change seemed to take place in all three men.

The Chief Rain-in-the-Face rose and delivered a spirited oration in a language that resembled none known on earth to-day; after which he bowed formally and resumed his seat.

The audience understood not a word of what he had said, and accordingly was duly impressed. Aloysius raised his hand to check applause that he saw was about to break forth, and turned to Mr. Black.

"Now, Theophilus Black, tell us where you are and what you see."

The reply came at once; but the words were spoken slowly, as if the speaker was obliged to translate his thoughts into a tongue with which he was unfamiliar:

"I am in a great city—the capital of the civilized world. On all sides, tall, white buildings rear themselves toward the sky, while the streets are thronged with busy people. There are also many horse-drawn chariots; but each year these grow fewer, for recently there has been invented a chariot that runs without horses. Since the invention of this

horseless chariot, the pedestrians, too, have grown fewer. The land is rich and powerful, and its scientists are the greatest the world has ever known."

"What is the name of this land?" Aloysius put in, endeavoring to control his excitement. So far, results were turning out far better than they had before.

There was a brief pause, Mr. Black said, then: "Its native name would mean nothing to you, but it has come down to you in legend as Atlantis."

A UNANIMOUS GASP arose from the audience. The authenticity of the mythical Atlantis was actually being proven! At this very moment, the man before them had returned there mentally through awakened race memory! No wonder they were excited and thrilled. I was myself.

"I have said that our scientists are the greatest the world has ever known," Mr. Black went on in the same hesitant, rather monotonous voice. "But recently they have fallen into disrepute; and all because they have predicted that which it does not please the people to believe.

"For many years we have known that the ocean bottom is rising. Our own coastal plains have been sinking; while our mariners report that in the distant reaches of both the eastern and western oceans, strange new islands have appeared. Our scientists have studied these reports, and announced that the appearance of the islands mark the beginning of a great cataclysm of nature, which will raise new continents from the ocean bottom, pouring the waters that now cover them over Atlantis, burying it forever. Naturally, the people are loath to accept such a prediction; for it seems to them impossible that Atlantis, the wise and beautiful, could ever perish."

"Does no one believe the scientists?" Aloysius asked.

"None but a few religious sects, who believe that the end of the world has been predicted. One of our merchants has taken advantage of their credulity, and has advertised in his shop a special sale of fine linen for ascension robes."

"When do the scientists predict that this great catastrophe will take place?"

"They say that it will occur about ten years from now."

Aloysius waited several seconds before speaking again. Then he said, "Six years have passed. The catastrophe is only four years away. Tell us what is happening in Atlantis now."

The reply came promptly. "Earthquakes have begun to shake our land. Two volcanoes have become active. The ocean bottom to the east and west is rising rapidly."

"Do the people still doubt the predictions of the scientists?"

"A few more have ceased to doubt. These are building large boats in which, if the water begins to rise over the land, they will flee to the small, barbarous continent of Yropa to the northeast. The boats are very large. They will carry animals and supplies as well as men and women."

"Blast me eyes!" exclaimed an awed British voice from the balcony. "A whole fleet of bloomin' Noah's arks!"

Aloysius gestured sternly for silence, and returned to his subject. "Now three more years have gone by. The disaster is only one year away."

The audience leaned forward breathlessly to catch the answer. This time the voice that delivered it was strained and tense.

"The sky is dark with the ashes from the volcanoes. Whole cities have been destroyed by earthquakes. Reports reach us that the sea has rushed in over a portion of Yropa, creating a large island off the west coast, where before was a peninsula. Also, a large tract

of land shaped like a boot has arisen out of the sea on the south of Yropa.

"At last the people of Atlantis believe that the scientists predicted correctly; but now it is too late. Most of the boats have already departed to establish colonies in Yropa and other barbarous places. As for the others, their captains grow rich conducting one-way excursions to the new islands. Atlantis is a doomed continent."

The voice moaned away into silence, like the last gasp of the dying civilization it described. It was echoed by the audibly released breath of the gallery.

From my place in the wings, I tried to catch Aloysius' eye. Surely the experiment had gone far enough and it was now time to awaken the subjects. Besides, during the last few minutes, Chief Rain-in-the-Face had shown distinct signs of restlessness, as if he was passing through the same mental experiences as Mr. Black, but was unable to express himself. To keep him in the hypnotic state much longer might lead to complications.

But Aloysius had not yet finished. A gleam came into his eyes that I knew only too well; he braced himself to launch the real climax of his experiment. "The hour of catastrophe has come!" he cried in ringing tones. "Atlantis is sinking! The waters are closing over it! Tell me what you see."

THERE WAS a moment of electric tension so strong it could have charged a battery. Then the answer came; but this time it was not in words, but in actions.

Before any one fully realized what was happening, Chief Rain-in-the-Face had leaped from his chair. The next instant he was heading for the edge of the platform, while his arms flailed about in perfect imitation of an English Channel swimmer. Pausing on the platform's edge for only a split second, he

executed a perfect swan dive into the lap of an obese lady in the front row!

Instantly pandemonium broke loose. Women screamed and men shouted. There was a mad stampede for the exits, in which everybody seemed to get in everybody else's way. One well-meaning soul, attempting to switch on more lights, pressed the wrong button—with the result that he turned on the emergency fire sprinkler instead, and streams of water began to spurt in all directions. We learned afterward that this caused several people to believe that the entire company had actually been translated bodily as well as mentally to sinking Atlantis, and were going down with it.

In vain, Aloysius entreated the crowd to be calm, assuring them that everything was all right. However, those people had but one thought in mind: to get out of there—quickly, while they still had their scalps.

In the excitement, the two other subjects of the experiment had been completely forgotten; and it is painful to contemplate what might have been the fate of at least one of them had not a faint, gurgling sound attracted my attention. I went to investigate. There was poor Mr. Black flapping about helplessly in his chair, emitting the most awful gaspings and groanings, like a man in the last stages of drowning.

"Aloysius!" I bellowed, striving to make myself heard above the surrounding din. "You've got to get Black out of the Atlantis period, quick! The poor devil can't swim!"

Leaving the auditorium to attendants and the police, who had arrived by this time to look after the commotion in front, we rushed to the assistance of Mr. Black; while Mr. McScribe peered out at us from beneath the speaker's table, a perfect example of the atavistic cave man gone to cover. Our star subject was in pretty bad shape; and even after he had been awakened from the

hypnosis, it was necessary to administer artificial respiration.

AFTER the excitement was all over, and Aloysius had been warned, by an irate police sergeant, that, "if there's any more av this foolishness, Professor O'Flannigan, ye'll find yerself in a cage with the rest of the monkeys," we were allowed to go home.

To my surprise, Aloysius was not nearly so downcast as I had expected. "I'll admit that matters did get a little out of hand toward the end," he said philosophically. "But, in spite of that, the experiment was a success. We certainly proved the one-time existence of Atlantis."

"I'm not so sure," I replied sourly. "I heard a couple of reporters say that the whole thing could be explained by pure mental suggestion."

Aloysius merely smiled. "Of course, there will always be skeptics," he said. "But I have material proof that cannot be explained away."

"Material proof?" I repeated. "What in the world do you mean?"

"For a long time," he began, "certain scientists have maintained that there exist ultra dimensions in time and space, which, if they were thoroughly understood, could be passed through physically as well as mentally. Now don't ask me how, for I'm not a mathematician. All I know is that, in some way, Mr. Black's mental rapport with the past became so strong that he was able to draw through these dimensions an actual, material specimen from the sinking continent of Atlantis. I took it from his mouth when we were reviving him. Here it is."

He put his hand into his pocket and drew out—by the tail—a little dead fish!

I stared at it incredulously. "Holy mackerel!" I gasped.

Aloysius shook his head. "No, Eric," he corrected, with his usual care for scientific accuracy, "just a sucker."



# TWO SANE MEN

*"The atoms of my brain were scattered—all over the universe—trying to get together!"*

by Oliver Saari

FROM seventy-five miles the earth looks like an immense, haze-filled bowl. The refractive effect of the atmosphere makes the horizon seem a high ridge, with the mottled blue, green and brown of the earth's surface sloping up to it. The sun is a blazing ball too bright to look at; yet the stars shine brightly in a sky that is a fathomless, empty black. The moon is so clearly outlined one can see the "rays" of Tycho with the naked eye.

Bennet Benson prodded Erasmus V. Davis, Ph.D., in the small of the back with a firm finger.

"I say the fuel's going to give out in another minute!" he yelled, striving to make his voice heard above the muffled thunder of the rockets.

The wiry little scientist waved his arm impatiently but did not turn from the instruments he was hurriedly adjusting.

"What of it?" he shrieked back. "Hasn't it been provided for? Shut up! I've just made the biggest discovery in——"

With a wide grin, Ben turned his attention back to the rocket's controls. Seventy-five miles—it was nearing eighty now—above sea level, and the pilot had nothing to do but wait for the fuel to give out!

Davis, the physicist, was oblivious to everything but his instruments, but the erstwhile stunt pilot found this a new and none-too-pleasant experience. Eighty miles up in a ship that had neither wings, propeller, nor motor! The liquid hydrogen rockets would blast them

up and up until the fuel tanks were empty; then they would go down whether they wanted to or not, dead or alive. What a flying tin can for a respectable pilot to be in!

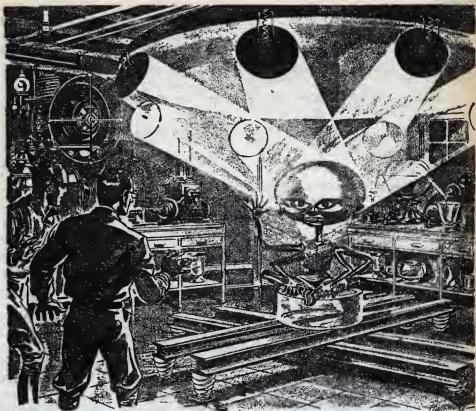
They were the first human beings ever to have risen above the Heaviside Layer. Tiny, unmanned rockets had done it before, but never a large, insulated one containing air-purifying apparatus and a crew. Just as, two decades ago, Piccard had attached a gondola onto a balloon and gone exploring into the stratosphere, so had the Smithsonian Institute evolved the small rockets into a large one, which was capable of carrying two men and a host of recording instruments for the study of atmospheric conditions and cosmic rays eighty miles above the earth's surface. The two guinea pigs were one Bennet Benson, stunt and test pilot, and Erasmus V. Davis, physicist.

Ben looked at the fuel gauge and grinned uneasily as he saw that it hovered near the zero mark. He cast a glance at the gray-haired scientist and yelled, "Now your time's up!"

The rockets would have to be shut off evenly, else the ship would roll over. Ben jerked the lever that cut the flow of fuel.

The sudden silence was deafening and the sudden disappearance of weight was worse. The two felt as though they were suspended by their stomachs from a skyscraper's flagpole. Ben was used to such sensations, but the little physicist was gasping helplessly.

Ben pulled No. 1 parachute lever and



*"Hello, Era—know me?" The question was soundless, but it was none the less clear.*

an immense silk umbrella burst out above the falling ship. The thin, ionized air of the Heaviside Layer did not give the parachute much traction, but it was enough to retard a free fall and give a semblance of weight to the men. The ship fell more and more slowly as the air thickened.

"Phew! What a relief!" sighed the pilot, his voice sounding suddenly harsh and loud in the stillness.

THE ALTIMETER registered sixty-five miles and was going down with decelerating speed. At sixty miles Ben felt very strange. A mighty force beat at his brain; his body became nerveless. The feeling hadn't been sudden; it had crept upon the pilot unnoticed, until,

finally, it was an omnipresent, oppressive force beating down his consciousness, relentlessly.

"Era—Era——" he gasped thickly. "What's the matter with me? I can't move or think. Something's wrong. Maybe the oxygen apparatus——"

The two men were sitting on the floor of the crowded compartment in dazed silence.

Ben was the first to recover. For a moment he found himself like a disembodied spirit, his consciousness strangely separated from his body; then normalcy began to return. He found that the rocket was still floating downward, the altimeter pointing to forty miles, and that apparently nothing had been changed. The air was pure enough, so

the oxygen apparatus had not been the cause of the trouble.

"What a sensation!" sighed Ben. "The atoms of my brain were-scattered all over the universe, trying to get together!"

Erasmus was biting his finger nails, a habit when deeply perplexed.

"We didn't feel that way coming up through this region," he mused. "Probably we suffered a dose of 'space sickness' or something of the sort."

Feeling normal again, they dismissed the incident from their minds. They could not have known its true significance.

At fifteen miles Ben pulled the lever that separated the ship from No. 1 parachute, and immediately afterward released No. 2—a smaller, stronger fabric.

"Well, Era, what did you find in deep, dark space?" he asked, as he sat back to wait for the inevitable landing.

The physicist patted his instruments lovingly. "It's revolutionary!" he exulted. "The cosmic rays are in greater force above the Heavside Layer, as we have surmised all along; but up there at eighty miles the queerest thing happened. I detected a flood of rays coming from the earth!"

"From the earth!" echoed Ben in amazement.

"Well—perhaps they weren't cosmoics after all; they reacted on the instruments a bit differently. But their direction was unmistakable, and they were far stronger than ordinary cosmic rays."

"Wouldn't they be felt now, too, if they came from the earth?" demanded the pilot.

The physicist shook his head. "No. The instruments do not show them any more. Whatever they were, they must have been a sudden spurt, not a steady flow—"

Ten miles up.

Far to the east, through one of the rocket's tiny glass ports, Ben saw the gleaming expanse of Lake Michigan.

However, it soon disappeared beyond the hazy horizon, as the wind bore the ship north and westward. The greenish-brown blur that was the ground became resolved into checkered farm lands, crisscrossed by white ribbons of pavement. A city could be seen, miles to the west.

Peering at the scene through a port-hole, Ben noticed something vaguely wrong. He had often seen the same type of panorama from an airplane's cockpit, but this looked different somehow. It was the utter lack of movement that puzzled him. Even on the country roads there should have been a moving vehicle or two; yet, the great, four-lane highway almost directly below them contained no traffic!

The rocket plunked into a freshly plowed field. The immense parachute was wafted toward the side by a gentle but insistent breeze, and the ship overturned with a jar. Ben bumped his head against a heavily padded wall and Erasmus bumped his on the pilot's anatomy. Luckily, the physicist's instruments were all securely fastened to their racks and no damage was done to them.

BEN spun the wheel that controlled the door plug, and the rubber-lined metal plate swung inward. Air hissed through the opening as slight differences in pressure were equalized. In another moment the two were outside.

"Well—where's the reception committee?" asked the pilot.

He looked across the plowed field in all directions, but nowhere could he see a sign of human beings. Strangely enough, their arrival had attracted no curious country folk to the spot. Surely the falling of a great metal torpedo that dangled from a white silk umbrella was not an everyday occurrence.

"Where is every one?" breathed Erasmus. "We had it calculated when we started from Marionet that we'd land

about here. There should be lots of people around."

Ben replaced the metal plug in the rocket's doorway and screwed it tight. "The instruments will be safe," he said. "Let's get going toward civilization, if civilization won't come to us."

A highway embankment crossed the fields within a few hundreds of yards of the rocket. The two men made toward it. Ben was about to surmount a barbed-wire fence, preparatory to climbing on the highway, when his eyes caught something that caused him to freeze. Several yards to the left a car had run off the road. From the position of the wreckage scattered around, the pilot surmised that the vehicle had leaped off the seventy-foot embankment, smashing into a tree.

Ben leaped over the fence and Erasmus followed suit, not as adroitly but in no less a hurry. The car had been a new, ultra-streamlined model, and it was completely demolished. Behind the steering wheel was a slumped, twisted figure about which there was no mistaking—

The two scrambled up the grass-lined embankment, onto the wide expanse of pavement. The road was a busy one—two dark stripes of oil-stained concrete testified to that; but not a car was moving on it as far as the eye could see! Ice water was trickling down the pilot's spine. It was evident that something was terribly wrong with this corner of the world.

A few hundred yards up the road a car was parked on the shoulder. Erasmus was the one to point it out.

"Perhaps those people can tell us what has happened here," he said, indicating a man and a woman who were sitting on the pavement near the car.

The little physicist was left behind as Ben loped at his best speed toward the machine. Still quite a distance from his goal, the pilot noticed something very strange in the postures of the two by

the car. First of all, they were sitting in the middle of the road, which is certainly no position for a sane, self-respecting human being. And their bodies were subtly twisted, somehow, into unnatural positions. They moved their heads with curious, birdlike jerks, as they turned to face the running man.

"Hello!" Ben shouted. "Is there something wrong? Can we help?"

The man scrambled to his feet, making ineffectual motions with his hands the while; then he tumbled over the embankment, rolled down limply, and trotted off across the field. The woman followed suit. Somehow the two used their feet as though they were not used to them, but they continued to move with fair speed.

Baffled, Ben pulled to a halt beside the parked car. The rear end was jacked up; evidently some one had been in the act of changing a tire and had been interrupted before he had finished the task.

Erasmus puffed up and gaped around in bewilderment. The man and the woman were still running across the field, casting no backward glances; they were moving toward a clump of trees.

NOW that Ben had a chance to view the whole countryside from this vantage point, the full strangeness of the scene came home to him. He saw several people now; but even from a distance he noted that their movements were purposeless. They were wandering about just as a herd of animals would have wandered. A group of horses in a pasture seemed to be acting naturally enough, but as soon as they moved, Ben saw that they, also, were affected. They seemed to have lost all the grace and majesty of our most useful ungulates, for they trotted with queer, jerky movements. Cows grazed here and there, but they were not natural in their actions. Even the plants seemed to have changed, although more subtly.

And the roadside was punctured every hundred yards or so with wrecked automobiles! Some distance ahead a pile of debris marked the spot where two cars had collided head-on.

The pilot could not stifle an involuntary gasp, "What—what has happened to everything?"

"Ask me something that is easier to answer," retorted Erasmus. "And tell me, why haven't the authorities traced the landing of our rocket and arrived by this time?"

Ben shrugged his shoulders helplessly, then said, "What do you think we ought to do? Hike along the road? Or should we take the car and——"

"I have no desire to be an auto thief," returned Erasmus, "but I think we really ought to take the car."

They clamped the spare tire on, then released the hydraulic jack. Ben sat in the driver's seat and started the motor.

"Where do you think we should go?" Ben voiced a question which was hard to answer.

An advertising billboard near by suggested:

**SLEEP as you have never slept before: the Nu-Ritz Hotel, Eau Claire—16 miles.**

Ben obediently sent the car hurtling toward the city.

"We might as well go to Eau Claire," he announced, "but first I think we ought to stop at some farm and try the telephone."

There was a large group of farm buildings just a short distance ahead, and the pilot pulled the car to a stop before them. Even as they made their way up the gravel walk they saw that, whatever the disaster had been, it had struck here also. The fowls were running to and fro in their inclosure, emitting such a combination of shrieks and croaks as a chicken never uttered before. A ferocious-looking watch dog peered

lazily at the intruders, then unconcernedly turned his head.

They rang the bell and rattled the door with no results. Ben turned the knob and the door opened easily; in another moment they were standing in the anteroom. The door to the living room was ajar, and a rather plump woman could be seen, sitting on the rug-covered floor. She was the first human being, affected by whatever had struck the country, whom the two had seen at close range, and the sight was shocking. Her eyes were devoid of expression; her chin, and a muscular chin it was, drooped limply; her body sagged, and she seemed to have difficulty in holding her sitting position. She turned to face the two intruders—apparently she was still faintly responsive to external stimuli—and stared at them blankly, making ineffectual motions with her hands.

The pilot saw a telephone on the table and strode over to it. He looked up the number of the Eau Claire police station and dialed it, but the instrument remained dead. A call for the operator evoked no response. Evidently the disaster had been spread over a wide area, for the city was sixteen miles distant from the ship, if one were to believe the hotel advertisement.

The woman was still sitting in the middle of the room when Ben nudged Erasmus out of the house. Probably there were other stricken people about the farm, but nothing could be done for them until the cause of the trouble was found.

They made their way back to the car. They had agreed to go to Eau Claire as soon as possible. Perhaps there they could find some hint as to the reason for all the incredible events of the past hour. The situation was very strange, to say the least. Only a few hours before, they had climbed into their rocket and soared upward into a dawn-tinted sky, pursued by the wild cheers of an enthusiastic crowd. Up but a short time—then they



had descended into the middle of a countryside where insanity reigned!

Countryside? Thus far they had seen no airplanes, which would surely have been buzzing over the area if the disaster had covered only a small portion. There was a radio in the car, but it would produce no sound other than violent static. Either the set was out of order, or there were no messages being broadcast from any station within hundreds of miles!

Ben's face was acquiring a grim look as he shoved the accelerator to the floor boards. The car was an old one—of 1937 or '38 vintage—but its motor had an even sound and its gasoline tank was three quarters full. It purred swiftly along the smooth pavement toward Eau Claire.

And everywhere there were wrecked automobiles. Sometimes the road was blocked by wreckage, but more often the cars had merely hurtled off the embankment. Traveling at speeds of eighty and ninety miles per hour, the drivers had lost control of their machines—

Several times they came upon cars that had stopped in the middle of the road; evidently some of the drivers, feeling the disaster overtaking them, had jammed on the brakes in time. The two saw to their surprise that these cars were occupied! Ben halted beside one to investigate, but, as he opened the door, the queer people looked at him with expressionless faces and made no move to get out.

AT THE OUTSKIRTS of Eau Claire their worst fears were realized; the disaster had struck the city in full force. The streets were filled with stalled and wrecked cars; stricken people wandered about everywhere. Here was an old gentleman, whose clothes proclaimed "well-to-do business man," sitting in the gutter with a foolish expression on his face. Here was a heavily painted young lady, whose thin, silken wrap was muddy and soiled, whose yel-

low hair hung in wet masses about her shoulders as she scrambled on all fours from the path of the oncoming vehicle. Here were people of all ages, each bearing a stamp of alien horror.

Ben weaved the car carefully through the littered streets, and Erasmus watched the chaos outside thoughtfully. Suddenly something seemed to strike a chord in the little scientist's brain, for he grasped Ben's arm.

"An old friend of mine, Edward Berkeley—who is at present a professor of physics at the University of Minnesota—predicted something like this several years ago! I remember now, . We were chatting over the teacups one afternoon, and he spoke of some new theory of his. If my life depended on it I couldn't remember what it was—the only thing about it which made any impression on me at all was that he mentioned just such results as those we have been observing for some time—"

The pilot was all attention. How he longed for some light of sanity to break on this madness!

Erasmus was still mumbling his recollections, "Edward—Eddie, I used to call him—lives in Minneapolis. I haven't seen him for two years, but I think I know where he would be at the present time. Perhaps we could—"

Ben cut in, "That's where we're going, then. It's only a hundred miles; and perhaps your friend would be able to shed some light on this thing—if it hasn't struck him, too!"

He stopped the car at a filling station and filled the tank to the brim with the best gasoline. At a luncheon counter the two appeased their growing hunger, unmolested by a white-aproned attendant and several customers who were littered about.

Out on the broad, straight highway once more, Ben gave the car all it could take. The miles passed swiftly, but nowhere was there a variation of the chaos: people, bereft of everything that had

made them human—all forms of life subtly changed. Smaller towns were mere chaotic replicas of Eau Claire. Two sane men driving through a world gone mad!

IN THE AFTERNOON they reached the outer edge of St. Paul and Erasmus took the wheel. The clock on the dashboard showed four thirty.

The city had not been spared from the fate of Eau Claire. Black clouds of smoke reared up here and there; the inevitable fires had broken out. Luckily, many of the buildings were of fireproof construction, else the single blazes would have grown into a city-wide conflagration. Twenty or thirty years ago the ravages of an uncontrolled fire would have been terrible.

Literally hordes of people were shuffling about purposelessly. Ben thought he saw a tiny spark of sanity gleaming from behind some of those immobile, senseless faces; in fact, several persons showed an almost intelligent interest in the moving car. Could the effects of the catastrophe be passing over?

At one place they found the street blocked by a street car that had run amuck, having finally been thrown off the tracks by a large truck, into which it had smashed. It was filled with people, some of whom were moving feebly, but most of whom were lying still.

Erasmus picked the roads which would not take them through the most congested part of town; however, progress was slow indeed, for it was very hard to avoid running over some of the helpless people. They stopped often and attempted to give first aid to many who had been injured by unguided, speeding cars, but the accidents had been so numerous that soon they grew inured to the sight of suffering. It is difficult to concentrate one's efforts on helping any single person when one is surrounded by a cityful of injured and dying. Moreover, the unfortunates seemed insensible

to pain and made no effort to help themselves!

The car sped along University Avenue toward Minneapolis. Erasmus guided it skillfully among the wreckage; Ben was forced to admire the little man's driving abilities, for he managed to keep a fair rate of speed in spite of the numerous obstacles. He swung it around a corner, down a lesser street, and brought it to a halt before a pretentious dwelling.

"This is Berkeley's residence; at least it was two years ago. I haven't been here since that chat I was telling you about, having been kept too busy by Smithsonian," explained the physicist.

"Rather a big place for an ordinary college professor," commented Ben.

"He isn't ordinary. He's one of the most brilliant men in the world. And he is possessed of a considerable private fortune—not at all dependent upon his salary."

Erasmus rattled the door while the pilot rang the bell, but neither evoked a response. They had not really expected one. Of course, it was foolish to presume that Dr. Berkeley had been unaffected by a disaster which seemed to have spared no one else in the vicinity, but the two sane men were clutching at straws.

The door was not locked, so they pushed their way in. Absolute silence reigned over the building; even their own footsteps were muffled by a thick rug, which covered the hallway floor.

They wandered through richly furnished rooms, discovering nothing until they came to one that was obviously a bedroom. Two small boys were lying in a large bed in attitudes suggesting sleep. The right wrist of each was encircled by a metallic band, connected by wires to a socket in the wall. On each band was a small bottle, half full of clear liquid.

"COME into the laboratory, Era," said a *soundless* voice, "and you too,

Benson."It came from all around, from the walls of the room, from the ceiling. Ben spun around on his heel, his gaze traversing three hundred sixty degrees, but he saw no one who could have been the speaker.

Petrified with amazement, the two found themselves walking through silent rooms, down a flight of stairs which, they knew somehow, led to a basement laboratory. The mysterious mental suggestion guided their steps.

They passed through a door into a room filled with sundry scientific apparatus. Several electric bulbs in the ceiling were lighted, undoubtedly supplied with current from a private source, for the city power had, of course, failed. It was the thing in the center of the room that caused them to gasp in horror.

A large, bowl-shaped mirror about eight feet in diameter hung from the ceiling. Eight smaller mirrors, replicas of the large one, each connected to the other by bundles of wire, were focused on a spot directly underneath the apparatus. At that spot was the strangest apparition that the two had ever seen.

It sat on a glass pedestal that was upheld by four metal beams, fastened to the floor. Its thin, sticklike legs were crossed before it; and it had two other pairs of appendages—strange, boneless arms that were frayed at the extremities into six-fingered hands. A hard, metallic-looking substance covered its trunk, which was devoid of clothing of any kind.

An immense, globular head, balanced on a thin neck, surmounted the creature, and this it pivoted toward the two men. Its features bore some resemblance to those of a man. It viewed the newcomers with two great, brown orbs, the pupils of which expanded and contracted with a regular beat.

"Hello, Era—know me?" The question was soundless, but it was none the less clear.

Erasmus was gaping at the thing on the pedestal with a horrified stare.

The thing contemplated the two for a while; then it said, "I was wondering how you had escaped the Change, but I understand now that you were up in the Smithsonian stratosphere rocket, above the Heaviside Layer, when it came about."

Erasmus was about to blurt something when the creature stopped him with a wave of thought. "You need not say it; merely think," it explained. "You are wondering what I am. At one time I was known as Edward Berkeley, a human scientist—your old friend, Era!"

"What—what has happened to you?" gasped the dazed little physicist. "And what has happened to all the other people around here?"

Something equivalent to a mental chuckle issued from the monster. "Not merely the people 'around here,' but the entire world is affected by the Change! However, it is not such a catastrophe to mankind as you may imagine. The people are not really insane. They were merely shocked by a sudden metamorphosis; their bodies and minds were thrown off balance by the great changes that took place within them. Even now, the shocked nervous systems are beginning to function, and order is emerging from chaos."

"But what is this 'Change' you mention? What has caused it?" begged Erasmus.

Either the thing did not catch the question, or ignored it for the present. "Do not imagine that the people of the world are in any manner unfortunate in being affected by the Change. You two are the unfortunate ones, for you have become apart from the natural course of life!

"The world has undergone a metamorphosis which occurs once in several millions of years. I foresaw it and was able to perform a little experiment upon

myself. Take a good look at me, Era, for I am a specimen of the race that is to replace man as the highest type of animal!"

The creature on the glass pedestal stroked its bulbous head with a flexible tentacle arm. It fixed its gaze on the two men, and the jumble of incredulous thoughts in their minds were forced aside by a greater will.

"LONG AGO," the understanding came, "I noticed a peculiar coincidence in the science of biology. Era, you remember my interest in the evolution of life? How I used to plague you with my radical theories concerning it, as we often chatted together?"

"No one has ever fully explained evolution. Darwin's theory of natural selection—the survival of the fittest—has been generally accepted. Plants and animals are said to evolve by adapting themselves to changing conditions, reproducing only those that are able to survive their environments. I have always seen something lacking in this view.

"The forms of life are separated into distinct groups, which the biologists have named phylums, assuming them to have a common origin, bound together by several mutual characteristics. It is the gaps between these phylums that the theory of evolution by natural selection falls short. For instance, no amount of selective breeding would have caused the simple, unicellular protozoan to evolve into the far more complex sponge, which is next in the line of evolution. Nor would the insect, with its jointed exoskeleton, have evolved into the fish without leaving some curious freaks in between—if evolution were a slow, even process.

"I have always held the opinion that, along with the slow evolution by natural selection, there is some sweeping change every few thousand years that creates

a new form of life in a single stroke. Late discoveries of fossilized organisms have enabled us to estimate at what periods the various forms of life were in their prime. With several discoveries of my own added to the existing data, I was able to prove these periods of equal length! Therefore I concluded that there must be some evolutionary force that occurs always after a definite number of years has passed.

"What is the most unfailing clock of all, by which Nature could time this force? The stars in their courses! The planetary bodies go through the same paths about the sun for a million years, changing their periods of revolution but slightly. I reasoned that if the evolutionary force occurred regularly, it must be timed by the motions of the planets, for nothing on the earth itself is so unchanging.

"As I said before, I had found the approximate length of time which seemed to have elapsed between each evolutionary change in the past. It was a comparatively simple matter to find what occurrence in astronomy had exactly the same period. Then I was able to formulate a more definite theory: Once in so many years all the planetary bodies, including comets and meteoric swarms (for both have definite orbits around the sun) are in a very definite relation to each other. In fact, the position is so striking that I was surprised it had not been noted before. I assumed that somehow this position of the planets liberated the evolutionary force, for the two events had coincided exactly in the past.

"And now, by exact and unfailing mathematics, I found that another evolutionary change was due in six years' time!

"Preliminary effects enabled me to discover in what form the Change would come. As the stellar bodies approached the fatal positions, I discovered a new radiation emanating from the earth! It

was very much akin to the cosmic ray, but of yet shorter a wave length, and the preliminary waves were so slight that I should never have found them had I not been looking for something of the sort with my instruments. I reasoned that the various gravitational forces of the solar system were forming a matrix at the center of the earth, into which the superheated, highly compressed atoms were falling, liberating the new radiation in the process. Just as cosmic rays are formed by the integration of atoms, so were these rays formed by the changing of one type of atom to another. It is one of those complex schemes by which Nature has made the evolution of life and the evolution of matter concurrent, coincident.

"Of course these were all perfectly wild conclusions for a scientist to draw from so little data, but somehow the idea had become an obsession and I devoted all my spare time to it. In my position as a professor in physics and a hobbyist in biology, I was well fitted to make use of my theories.

"Knowing the time at which the Change would come, I decided on a little experiment. Several years ago Hargreave synthesized a substance that reflects cosmic rays. I found that this substance also reflected the evolutionary rays, and I intended to concentrate the rays upon myself to see what the effect would be. I fashioned a machine which would increase the power of the rays tenfold.

"I had no way of knowing at first whether the Change would be sudden or gradual, but, as time went on, I was able to determine almost the exact time at which it would come. I had no illusions of attempting to warn the world; you know what the effect would have been had I so much as hinted my ideas to any one. A short time before the fatal hour I placed my entire family under an anæsthetic, to save them from any ill effects which the Change might

bring—has brought. They will sleep until I shut off the current from the mechanisms that automatically administer the sleep-producing drug every four hours.

"And now the Change has occurred. You were spared from it because you were shielded from the rays by the Heaviside Layer. Most of the people on earth were affected, but in them the rays have merely altered the genes, and the greater aspects of the Change will not become apparent until the next generation. Somehow the concentrated beam accelerated the metamorphosis in my body, and changed me directly into a new type of creature! However, I feel that the strain has been too much and I do not have long to live.

"You can see that I differ from any animal previously seen on earth. I have six external appendages, two of which I use for locomotion, four for other purposes. I have both an internal and an external skeleton, where each is most convenient. I have a four-lobed brain that is able to transmit thought waves and——"

IN the year one hundred, after the great Change, the new race was well established on the earth. The old cities had been torn down and new buildings of fantastic shape were taking their places.

As the semimythical Edward Berkeley had predicted, the creatures of the world soon recovered from the first shock of the Change. When incredible monstrosities began to appear in the place of human offspring, the people had to believe what the great scientist had announced to them just before his death, which came soon after the evolution.

New types of animals appeared on the earth, but the old did not disappear, and life began another period of adaptation that would continue until the next Change!



# ONCE AROUND

**T**HIS is the story of Lee Baron. Perhaps you have heard of him in connection with the international balloon races. He was quite an expert in this method of aviation. More likely, though, you heard of him when he made the front page about a month ago by disappearing on a flight to Nome, Alaska. He flew his own plane, an amphibian.

You must certainly have heard of him about three weeks ago, when his return caused considerable stir in newspaper circles. He was picked up in a speed boat off Koonak Bay, Alaska, after the eruption of a volcano in the vicinity, suffering from burns, shock, exposure and a fracture of the spine that left him paralyzed from the hips down. He was brought to Vancouver for treatment. He recovered as completely as could be expected, and I'm willing to swear he was perfectly sane and in full possession of all his faculties when he told me the incredible story of what happened during his month's absence.

Because this story is somewhat unbelievable, I would like to submit these facts in corroboration before I start.

The registered owner of the speed boat in which Baron was found was a Professor Burns. You will see the significance of that later.

Also, a shipping company in Vancouver has records of delivery of a large quantity of cement, several mixers, a considerable amount of hoisting and mining machinery, dynamite, food supplies and, in fact, everything necessary in the carrying on of extensive mining operations. These were all delivered in Koonak Bay and consigned to Professor Burns.

Thirdly, a week ago, a fish boat returning to Vancouver from a cruise up the coast, brought in a piece of steel

plate about six inches thick. They had picked it up at the foot of the lava flow in Koonak Bay, shortly after the eruption. The piece was about three feet long and some twenty inches wide, nearly rectangular and, as I said, about six inches thick. It was a curved segment of a circle about thirty feet in diameter. The material was the finest nickel-steel armor plate and the inside had a smooth, machined finish.

I have known Baron all through high-school days and have seen quite a lot of him since. His father was German and his mother English. I have never come across any one with less nerves or imagination. When he told me this story in his private ward in St. Paul's Hospital he was dying and he knew it. He accepted the fact of his impending death as calmly as he had faced the risks of balloon racing, and there was nothing in any way abnormal in his behavior.

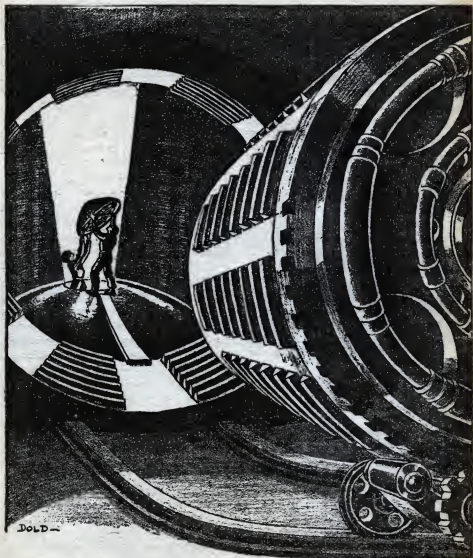
These facts speak for themselves. I submit them without comment. The following is the story related to me by Lee Baron two days before he lapsed into a coma from which he never recovered:

**AS YOU KNOW** I started out on that round-the-world tour from Seattle. I reached Juneau all right, refueled, loafed around for a day and then started for Nome. It was on that hop that I disappeared.

I was about two hours out of Juneau, visibility unlimited and the country spread out like a map beneath me. The coast was twenty or thirty miles to my right. Three or four miles ahead, to the left, there was a small lake in the crater of an old volcano. At that time the lake was only part of the scenery. Just after I sighted the lake the engine started to miss; it caught and fired all

# THE MOON

by  
Vic Phillips



*It dropped solidly to a perfect fit— We had seen the last  
of Earth until our return—*

round again for a minute, then started missing again worse than before and finally stalled altogether.

Sea water was too far away to be any use. The country up there is all right to fly over but it's no place to get

out and walk. The lake was the only level place in sight.

I headed for it, went past about five hundred feet up, lost plenty of height on the turn and headed back into the slight west breeze that was blowing, coming in

over the edge of the crater just as close as I could without scraping the paint off the bottoms of the pontoons. The plane sat down perfectly, tore across the lake and then ran into some one's brick wall. I found out later it was just that—only it wasn't brick; it was concrete.

The landing gear wasn't built to take that kind of treatment, so it stopped where it was. The fuselage and I went for another twenty feet and there we parted company. I went on by myself for about another ten yards. I hit the water and I guess it knocked me out.

The next thing I knew I was looking at the *Graf Zeppelin* wrapped around a slowly revolving skyscraper, and then it turned into a hand holding a flask of brandy to my lips. I swallowed a couple of times, felt better, sat up and looked at the lake. It was still rippled but there was no sign of the plane.

"She sank," said a voice behind me.

I turned around and saw a six-foot, shock-headed Swede. He was wearing a coarse overall; his shoes were off and he was soaked. I came to the conclusion it was he who had pulled me out. I said, "Thanks."

He said, "Don't mention it," and sat down to put his shoes on.

I stood up. "Well, where do we go from here?" I asked.

"Down to the mine."

"Have you got communication with the outside? Could I send a message?"

"Yeah, short-wave radio. You'll have to see the boss about sending any message."

"O. K., let's go see the boss."

THE SWEDE didn't say any more, just tied his shoes, got up, and walked to what looked like the timbered entrance of a horizontal mine shaft in the crater wall. We went in some sixty yards, to where the tunnel ended in a vertical shaft that went down as far as I could see. It was dimly lighted by

electric-light bulbs fastened, about fifty feet apart, to a steel ladder that was attached to the side of the shaft.

The Swede ignored the ladder and wrapped his legs and arms around a steel pipe that dropped fifty feet to a platform, like a fireman's pole. He climbed down the ladder to where the pipe continued under the grating platform. He didn't look up, so I followed him. We went down about six hundred feet before we came to the bottom of the ladder, where it ended on a solid platform that led off into another horizontal tunnel.

The shaft continued on down. It was bridged across with steel girders on which was mounted a hoisting winch carrying about six lines and run by an electric motor. I found out later that it was the head of their elevator shaft. I also found out that the tunnel went right to the outside of the mountain and ended in a ledge that was used as a lookout. It was from there that the Swede had seen me; that was how he came to be on hand at just the right time. We didn't go all the way along the tunnel, only about thirty feet and then down a shaft and back to the elevator, a sort of detour round the shaft head.

We stepped into the elevator. It was a steel basket with a wooden floor and a control box in one corner. The Swede said "Hold on," and then I think he cut the rope.

We dropped and kept on dropping; it must have been about two thousand feet. I had to keep swallowing to keep my ears from buzzing. Then we slowed and stopped so fast I sat down.

The Swede helped me up and said that we were about at sea level. I was quite willing to believe him. I got out of the elevator and looked around. The shaft ended in a huge tunnel that ran straight toward the center of the mountain and out in the direction of the sea. The cage had landed on a trail cut in

the side of it. To the right of the trail the wall curved away up into the roof. I could just see it dimly. Some ten feet down to the left I thought I saw the floor of the tunnel, but then I heard it suck and gurgle and saw it shimmer under the lights alongside the trail. The Swede explained that the tunnel was a natural seaway that ran right out to the coast. They brought all their supplies in that way.

We went along the trail a way and turned off into a side tunnel that ended in a door. The Swede told me to wait and went inside. He came out again and said the boss would see me. He looked at me kind of funny.

I WENT IN. Straight in front of me was a desk with a couple of telephones on it. Behind it sat a middle-sized, gray-haired man. He looked very average and a bit dazed. He looked right through me and didn't say anything.

On the floor was a man on a stretcher, with his head bandaged; another man, kneeling, with a medical kit open beside him, was bandaging the other fellow's leg to a couple of splints. Two other men in overalls were standing alongside looking rather helpless. I took another look at the man on the stretcher and then I recognized him. It was Roland Eindecker. You know him. He was my partner in two or three races, about as good a balloonist as there is. His face was colorless and he was unconscious. In fact, I thought he was dead. I turned to the medico.

"What happened to Roland?"

"Some rock fell on him."

The man at the desk seemed to wake up; he appeared almost excited.

"Do you know Eindecker?"

"Sure I do," I said. "We used to race balloons together."

"Are you a good balloonist?"

He waited for my reply as if I had

been the foreman of a jury. I told him I was and that started things.

He didn't turn round; he bounced, and if there is such a thing as shouting quietly, that's what he did. He told the two fellows who were standing to take Eindecker down to the hospital and then stand by to go ahead.

Then the gray-haired fellow turned to me and asked me to sit down. We sat at the desk. He introduced himself as Professor Burns. I don't think you've heard of him, but he was an authority on ballistics and rockets, among other things. He asked me what I wanted and I told him how I'd got there and that I wanted to send a message outside to get some help to salvage my plane.

He was quiet for a minute. Then he told me that there was no radio. I asked why.

He explained that they had been moving the transmitter because the room where it was had shown signs of collapsing. They hadn't been soon enough; there was a heavy fall of rock. The whole of the outfit had been smashed and Eindecker injured.

That seemed reasonable enough, so I asked him how soon I could get word out.

He said not for a week anyway.

Then he started talking. His voice was nothing unusual, but he had something on the ball I'd never heard before. Once he got going I didn't get a chance to say anything and I didn't want to. I was content to sit there and listen as long as he wanted to speak. I think I was three parts mesmerized. Looking back now I think the whole crew around there was more or less under his influence. Anyway, what he was telling me was arresting enough to hold any one.

I can't give you any idea of the way he spoke; I don't remember any of the words; I'm not even sure he did speak. All I know is that when he had finished

I understood everything he had said. It seemed as if I had known all about it from the start and it appeared perfectly reasonable that I should fall in with his plans.

## II.

WHAT he told me was briefly this: The system of shafts and tunnels was not a mine. The obstruction that I had hit in the lake was not a rock but the coaming of a thirty-foot reinforced concrete shaft that was sunk two miles vertically into the heart of the volcano, right down to the lava beds. The whole shaft was lined with armor-plate steel.

The entire business was for the purpose of making an attempt to circumnavigate the Moon. By the time he got that far in his narration I just swallowed it and sat there without batting an eye. The way he told it it seemed quite as feasible as circumnavigating the block.

The method he proposed was unique and simple. The lake was to be drained into water-tight caverns immediately about the lava beds. I didn't know it at the time, but Professor Burns was so sure of winning my coöperation that he had ordered the filling of the caverns to go ahead.

In the bottom of the vertical shaft was a piston, about sixty feet long, made of thirty-foot fabricated steel disks fastened one above the other with girders and tie rods. Three hundred feet farther up the shaft was the rocket ship. I took the rocket ship in my stride; I'd been half expecting it and by this time I was willing to believe anything.

The rocket fuel was liquid oxygen and benzene. The ship itself was teardrop streamline in shape and made of steel and duraluminium. It was one hundred and twenty feet long and thirty feet wide at the widest part, completely filling the shaft. Around this widest part were placed two removable rings, like piston rings, fitting snug to the sides of

the shaft. They were designed to drop off when the ship was in flight.

When everything was ready the water held in the caverns was to be teemed into the red-hot lava beds, and when enough steam pressure had been generated, a valve, opening from the center like the shutter of a camera, would be opened in the bottom of the shaft. The steam would force the piston up and riding on the air cushion ahead of it would go the rocket ship like a shell from a giant gun. It sounds simple enough, but there were a lot of problems involved.

There was, for instance, the problem of protecting the occupants of the ship against the shock of acceleration. This was done by constructing a tube, down the middle of the ship, large enough to accommodate two persons. The tube was filled with oil and the crew sat on the top of a piston in the nose of the ship. The acceleration drove the piston down the shaft, compressed the oil and forced it, through a small opening, into tanks. Thus the shock was absorbed enough to keep the fliers from being compressed into a small heap in the tail of the ship.

The next greatest problem was the heat generated by air friction while the ship was passing through the atmosphere. The way Professor Burns got around this was, to my thinking, sheer genius. Practically the whole of the exterior of the ship was covered with shell radiators through which water was circulated. The heat generated would convert this water into steam; the steam would be exhausted through the rocket tubes, not only keeping the ship cool but also cutting down on the supply of fuel it was necessary to carry.

Then there was the business of making a landing when we got back. That'll give you an idea of how far gone I was. I was thinking of when we got back, not if, and I was regarding the crew as we, not them. There was to be no attempt to land on the Moon, so there was



only presented the comparatively simple problem of making a landing in an atmosphere. To do this a balloon large enough to support the ship was packed inside the bow, around the shock-absorbing tube. A supply of liquid helium was carried to inflate this.

Just before the ship entered the atmosphere of the Earth, on the return trip, it would be brought to a standstill in relation to the rotation of the Earth. With no centrifugal force to counteract gravity, the ship would fall toward the Earth but would be arrested by its rocket power as soon as it entered the atmosphere. Then a group of electric heaters would be used to heat and expand the helium. A small pilot balloon would be shot out. This would drag out the main bag as it was inflated by the expanding helium.

That's where I came in. The professor seemed to be everything but a trained balloonist. I was to pilot the balloon back to Earth. Eindecker had been slated for the job, but his accident in the radio room ruled him out and Burns was all prepared to postpone the flight, when I showed up. He jumped at the opportunity and began to work on me immediately, with the result that by now the whole business seemed quite reasonable to me and I was entirely prepared to step into the rocket ship as soon as Professor Burns gave the word. That wouldn't be for three hours yet, he said; it took quite a while to move all the water. During that time we ate and he explained further about the flight. Everything was ready.

THE COURSE of the ship would be directly away from the Earth, propelled by the initial thrust from the volcano, supplemented by its rocket power. When it reached a point far enough from the Earth so that centrifugal force would balance gravity, the ship would be swung into an easterly orbit around the Earth. By traveling in an easterly

direction full use would be made of the centrifugal force created by the Earth's rotation. This force, augmenting the increasing speed of the ship under the influence of its rocket motors, would finally overcome gravity and the rocket would be flung outward into space.

Professor Burns had at some time gone into a supermathematical trance and come up with all the necessary information to enable him to pull the stunt by circling the Earth only once and giving the ship the gun at just the right moment to throw it in the direction of the Moon.

On entering the zone of the Moon's gravitational influence the ship would be turned by spinning, weighted wheels in its interior, so that its rocket power could be used to slow its orbit around the Moon until the Moon's gravity pulled the ship close enough to make detailed observations. When the Moon was approached close enough the rocket power would be used to speed up the orbit until it balanced the Moon's gravity. It would hold this course once around the Moon and then accelerate until centrifugal force moved the ship away from the Moon, the time of leaving so calculated that it would move in the direction of the Earth.

The return to the Earth would be made in the same manner as the approach to the Moon and the landing made by balloon as I have already told you. The whole course would be in the shape of a Figure 8, with the Moon and the Earth as the two centers. Professor Burns said that he could so direct the flight that our landing would be made in, or very near the crater from which we were to start.

Then he suggested that we go and give the ship a final inspection and check over the other arrangements. We went out along the passage to the seaway, then along the trail toward the center of the mountain. We passed the elevator shaft down which I had come and went on.

Just past there the seaway was blocked off by a long concrete ramp on which tracks were laid. The tracks rose to the level of the trail, ran along about a hundred yards and ended in a blank concrete wall that soared upward and disappeared in the darkness overhead. It had a horizontal, convex curve, and Professor Burns explained that it was the outside of the concrete reinforcing around the main shaft.

In front of the wall was another electric motor, elevator, winch and cage, with a small shaft dropping out of sight into blackness. We stepped into the cage and did another breath-taking drop. That seemed to be the only method these people knew of operating an elevator. We went down about the same distance as the first one had, transferred to another elevator, then to a third and finally a fourth before we reached the bottom of the main shaft.

All this time I had been conscious of a subdued roar that didn't seem to come from anywhere. I only really noticed it when we reached the bottom of the shaft and it died away and stopped. I asked the professor what it was and he said it was the last of the water coming down from the lake.

WE APPROACHED the main shaft and I saw what looked like the circular steel door of a bank vault. Around a quarter of the circumference of one edge ran a segment of a ring gear and, engaging this, was a small pinion fixed to an axle and driven by an electric motor. On the floor, leading away from the door, were a pair of heavy-gauge steel tracks.

Professor Burns switched on the motor. Slowly, the massive door described a quarter turn and slid out along the tracks. It was fully fifteen feet long, built like the breech block of a big gun. A blast of hot air followed it out and I realized for the first time that I was sweating profusely.

While I was watching, the Swede showed up from somewhere, carrying a coil of electric extension cable with a light globe on one end. He plugged the other end into a socket by the motor and entered the aperture left by the door. Professor Burns and I followed him.

We went through into the shaft. Two feet below the edge of the door the curved, overlapping steel leaves of the great valve stretched away into a perfect geometric pattern. About eight feet above the giant piston loomed darkly. We stepped in onto the valve. Heat rose from it in waves and when I touched it I could scarcely bear my hand on it. Professor Burns walked carefully along each seam, feeling with his hand for any hint of draft. Evidently he didn't feel anything, for he straightened up and we went out. The door was rolled back into place; the motor hummed and it turned slowly to lock for the last time before the flight.

Burns turned to the Swede and asked him if the water tanks were all ready. He said they were. Then we all stepped into the elevator and were whisked up three hundred feet or more. We got off and went through a passage that ran a quarter of the way around the shaft to another similar door. The same procedure was followed; the door rolled out and the Swede went in ahead with his light; we followed, and for the first time I got a glimpse of the rocket ship, or at least the nose of it.

It appeared huge in the confines of the shaft. The surface was perfectly smooth and burnished to a high luster to reduce radiation and absorption of heat. Rivet heads were countersunk and polished smooth, so that they were almost invisible. No heat got past the piston rings around the ship's middle, so it was comparatively cool up here.

Above the gleaming nose of the ship was built a wooden scaffold right across the shaft, level with the three-foot man-

hole in the center of the nose. On the scaffold beside the manhole was a cover made somewhat like the door of the shaft. It was about two feet thick, made of duraluminium, hollow and strengthened with interior bracing.

We went across the scaffolding and climbed down a ladder hanging inside the shock-absorbing tube that was empty as yet. About fifteen feet down was a handle recessed in the wall. Professor Burns turned it and opened a door. He stepped through. I followed him. We were in the living quarters, consisting of four rooms, one each for the professor and I and the observation room connecting with a corridor running right around the ship. It was crowded with a dozen different instruments and a whole carload of equipment that didn't mean a thing to me. The fourth room was the commissary. It was packed to the ceiling with food supplies and also contained a small kitchenette.

On the next floor below was our water supply, sanitary equipment, the control room for the ship and the tanks in which the shock-absorbing oil was stored and to which it would return after being expelled from the tube, as well as the circulating pump and the steam-pressure head of the cooling system.

Next below were the carefully insulated liquid-oxygen tanks, which were to replenish our air supply as well as serve for rocket power. Here also were the tanks of liquid helium for inflating the landing balloon. Below this, and separated by a heavy steel and asbestos partition, was the supply of benzene which was the second constituent of our rocket fuel.

WE FINISHED the inspection and went out by the manhole. Just before we left Professor Burns turned on the oil pump that would fill the shock-absorbing tube. The piston was already in sight and following us up when we climbed out. The scaffolding had been

all taken down and passed out through the door, except a couple of planks. We stepped over the manhole cover and went out into the elevator shaft.

Some ten or a dozen men were gathered there in the dim light. They comprised the whole of the crew. Burns shook hands all round, said good-by, reminded the Swede that he was in charge until we returned and had him repeat his orders. By the time he had finished most of the men had left by the elevator and returned to their posts. The professor, the Swede and I turned back into the shaft and returned to the ship.

I saw that the piston had now reached to within six feet of the top of the tube and was still. The six-foot top section was smaller than the rest of the tube and was arranged to telescope down inside it to leave a space through which the landing balloon would be shot out. The piston head was equipped with a pair of rubber hammocks slung between steel stanchions. Between the hammocks a length of rope ladder was coiled.

We swung down into the hammocks and the professor turned on a light hung on one of the stanchions. Then he stood up and helped the Swede lower the manhole cover into place. It dropped solidly to a perfect fit, made a quarter turn and locked, making a gas-tight joint. We had seen the last of the Earth until we got back.

On the side of the tube just below the manhole cover were a pair of hooks. The professor fastened one end of the rope ladder to these. It would coil out as we were forced down the shaft and we would climb up it to reach the door communicating with the rest of the ship. Then he plugged a small telephone into a socket in the cover and spoke to the Swede. He asked if the cover had been removed from the top of the shaft. He said it had and that everything was ready to open the valves and pour the water down onto the red-hot lava beds. The professor took a deep breath,

said go ahead and yanked the telephone cord from its socket. He turned to me, said we'd be under way in about eight minutes and told me to settle down in my hammock. I did. I was sweating all over. I waited several centuries, then looked at my wrist watch. Two minutes had gone. Then I lay back, determined not to look again.

### III.

A COUPLE of million years went by this time and then I saw the stanchion stretch out above me. It wasn't that; it was the hammock stretching as I was forced down toward the piston head. We were sliding smoothly up the shaft at an ever-increasing speed. Lower and lower the hammock sank, until I could feel the pattern of the webbing press into my back. Then a rung of the ladder crawled by my head. The piston was beginning to recede down the tube. A weight was pressing down on my chest and getting heavier. Breathing became difficult and my arms, legs and head were pressed back so that I couldn't move a muscle.

I looked up at the top of the tube. It seemed dim and far away and a crowd of red spots were chasing each other about all over it. Another rung of the ladder slid by. They were going faster—another and another—and still the terrible pressure kept increasing until the hammock webbing seemed to burn into me like red-hot iron. Everything went black. Then I came to again. The ladder rungs were stepping briskly past, only there were two ladders. I struggled to get a breath. A mist of oil hung around the light. I was conscious of increasing heat and then I went out completely.

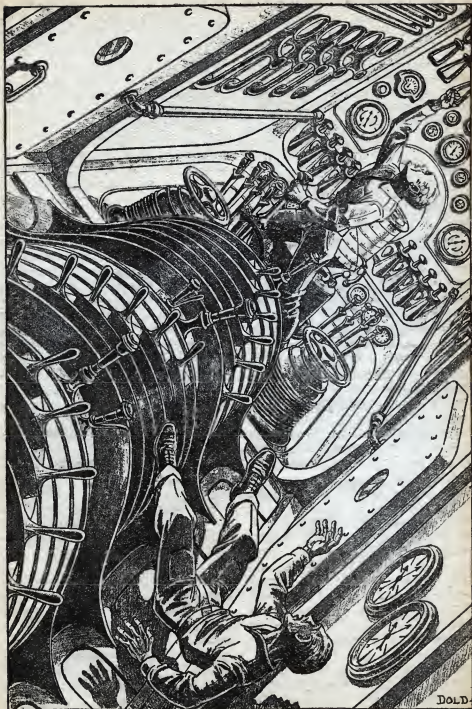
When I recovered the first thing that registered was a taste of oil in my mouth and then the smell of oil. The air was thick with it and stiflingly hot. I opened my eyes; the lids felt heavy and

sticky. I saw the professor sitting up in his hammock rubbing the back of his neck. His face and hands had a light-brown, glistening coat of oil. Then I realized that I ached all over and was utterly exhausted. Breathing hurt intolerably. The ladder snaked into the misty darkness overhead.

The professor turned to me with a sickly grin. Then we both noticed a thin wisp of smoke coiling up from the lamp globe. Burns reached up and switched it out, plunging us into absolute darkness. I sat up slowly. I heard his voice boom down from up the tube, telling me to come on up the ladder. I struggled painfully to my knees and felt around for the ladder. My hand touched it and I pulled myself to my feet. The ladder was slippery with oil but it was ridiculously easy to climb it. In spite of my stiffness, I seemed almost to float up. It wasn't tight under my weight and swayed lightly around from one side of the tube to the other. We must have been getting out toward the thin edge of the Earth's gravitational influence. It was almost like swimming under water.

I felt the ladder sway around above me and then the beam of a flashlight cut through the murky brown oil haze as Professor Burns looked for the door handle. I climbed up quickly and reached him just as he got the door open. He swung through and held the light while I followed; then we closed the door to keep the oil fumes out.

THE PROFESSOR immediately went down to the control room and I tagged along. He looked at our course chart and started spinning the weighted inertia-control wheels. The chart consisted of a slowly revolving recording drum on which our course was marked by a red line on a graph sheet. It rose in an abrupt curve, representing our acceleration. The vertical variations in the line represented our speed, while



*I started to get to my feet when the wall slapped into me. Professor Burns was spinning more valves, making final adjustments—*



the length of the line represented the time for which that speed was to be maintained.

There were notations all around the drum indicating at what point the ship was to be swung into its orbit, how much rocket power to use and how many turns of the control wheels necessary to execute these maneuvers. Following this line was a recording needle tracing a black line and controlled by instruments actuated by the varying influence of the Earth's and the Moon's gravities. The ship was to be so operated that this second black line lay exactly over the line representing the course. So long as they coincided the ship was on course.

I noticed that the needle was right on the notation indicating that it was time to swing the ship into its orbit around the Earth. That evidently was what Professor Burns was up to. The floor began to tilt steadily. I felt myself falling. I came down gently and quietly, fell in a heap on the side wall of the ship that was now the floor.

I looked around to see how the professor was doing. Of course he was on his feet; he knew what was going to happen and there were a lot of things handy to grab hold of where he was. He stepped over and started operating a panel of valves that had been on the ceiling, then he reached up and closed a switch. Judging by the results I guess it was the ignition switch for the rocket motors. I started to get to my feet when the back wall slammed into me. My head came up against the wall. As I lay there with my ear against the steel I heard a subdued, increasing roar like high-pressure water running through a pipe.

I sat there a bit dazed and watched Professor Burns spinning more valves, while the roaring grew and increased until it was quite audible in the cabin. I looked at the course chart again. The needle was following our acceleration curve exactly. Burns made some final

adjustments and said all we had to do now was wait for about five hours, until it was time to give the rockets full power and stand by to leave the sphere of the Earth's gravitational influence.

We went up to the observation room. The professor immediately monopolized two of the ports with moving-picture cameras, then started worrying about with the cosmic-ray detector and all the rest of his instruments, ignoring me completely. I went over to one of the side ports. The ones toward the Sun were tightly shuttered. The sky was a deep indigo, utterly intense; the stars were bright with an almost inconceivable clarity.

The immaculate perfection of the scene did not, somehow, indicate newness or age but a timeless, implacable fixity—an immutable elemental completeness that had always been, with no possible thought of change, error moderation of indefiniteness. There was an air of tremendously complex, complete simplicity; everything that could be had been; no one thing was newer or older than another. Each element was individual and perfect in itself, unique and definite with no overlapping or shading, and each was fixed in its relation to the others. It seemed as if everything could be seen at a glance and once seen was finished with.

I closed the port and opened one in the floor to see what could be seen of the Earth before we finally left it. We were far enough away to realize its spherical shape, yet close enough to receive an impression of tremendous hugeness. The surface of the planet was completely obscured, the outline we saw was that of its envelope of atmosphere. This was shaded from a deep blue at the center to a gossamer haze of infinite delicacy at the edges.

We were too far away to see clouds or any other recognizable features. Somehow the thinnest outside edge of the atmosphere envelope did not seem

in any way less substantial than the almost blue-black center, and was absolutely clear-cut.

I HEARD the professor struggling around and looked up to see him moving another camera toward the port I was using. He asked me to give him a hand. It was a big, cumbersome instrument with seven lenses set in a circle around the front. We shifted it into position and bolted it down to holes tapped into the floor.

I looked at Burns' oily hands and realized that I was still pretty greasy myself, so I went to the wash room and cleaned up. I came back to the observation room, saw Professor Burns was still busy focusing the camera, continued on to the commissary and dug up a pair of clean overalls. I was just beginning to think about eats when he shouted to me to get some ready while he washed up.

We ate. The professor made a last check-up on the instruments and the ship controls. Then we turned in to get some sleep. I didn't realize how tired I was until I lay down. I thought I'd never get up again; I felt too tired to sleep. Gradually, however, the low, steady roar of the motors lulled me into a doze shot through with visions of endless tunnels, shafts sinking to infinite depths, stars staring at me out of a deep-indigo background with a cold, lifeless brilliance, a tremendous spinning, hazy mass that grew and grew, blotting out everything and finally engulfing me in oblivion.

I guess I slept about five hours and woke choking, all doubled up and jammed against the wall at the head of my bed. The ship had now accelerated to its maximum speed and was swinging away from the Earth with the rockets roaring wide open. I was wide awake almost immediately in the highly oxygenated air we were breathing. I rolled out and went into the observation room. We were standing on end

again and our inertia would act as our gravity from now until we were within the Moon's zone of gravity.

The professor had adjusted the controls, checked over the instruments and was now busy getting breakfast. I went around all the ports looking for the Earth or the Moon or something that I recognized. There wasn't anything that looked at all familiar. I asked the professor to explain. He said that our stern was toward the Earth and the Sun and Moon were somewhere in our blind spot ahead. The view from the ports was not very interesting after a while, in spite of its novelty, so I went and had breakfast.

After breakfast we moved some of the cameras around, loaded them with films and filed the full sheets from the various recording instruments. About four hours later we ate and then again in another four hours, sleeping whenever we felt tired, which was not often. We talked quite a lot and I suppose the professor got my complete life story, but in some way I didn't seem to learn anything about him. He spent some time describing and explaining the various instruments to me, but he wrapped his explanations so deep in technical language that I wasn't much wiser.

#### IV.

THAT WAS our routine, with very little variation for sixty hours or more, until we sighted the Moon cutting into the edge of one of our ports. We were approaching on the Sunward side and the mountainous irregularities of the surface, casting no shadow, were almost invisible in the glaring white Sunlight, except where they cut the sky line like the edge of a broken slate.

Our floor shifted back to the side wall. For the next two hours we were busy moving equipment and setting the cameras in position. By that time the image of the Moon completely filled the port

as we swung swiftly toward the Sunset.

As the shadows began to lengthen I got some idea of the tremendous size of the vast craters and long pressure ridges that seemed to scar the entire surface. These terrific Moon mountains were like nothing seen on Earth. Some of them seemed almost crystalline in their sharp-cut outline, while the crater edges were broken up with towering spires and scored with unbelievable gorges, dwarfed by distance into the most delicate fretwork. Every detail stood out with perfect clearness in that lifeless, airless world covered with the dazzling whiteness of its crystallized atmosphere. Soon we passed through the shadow land and into the night sky as abruptly as though a light had been turned out.

Now came the most critical part of our flight. The ship was to be swung sideways with its stern toward the Moon, floating on its throttled-down rockets, in order to get photographs of the Sun's corona as we dropped behind the Moon. It was then to be straightened away into its narrowed orbit and accelerated to keep clear of the Moon and gain sufficient speed to enable us to stand on end again to get pictures of the Sunrise. The professor was to be at the controls while the battery of cameras was left in my charge. Burns went into the control room and the floor began to shift again.

Slowly, the blazing disk of the Sun crept across the port, with the edge of the Moon following and steadily gaining. As I adjusted the cameras I saw, through my smoked glasses, the fascinating, glorious spectacle of the Sun's corona. Stupendous explosions of flaming hydrogen writhed and twisted skyward, mushroomed out into clouds and sank again—in complete un-Earthly silence—while the curve of the Moon crept steadily across the face of the Sun. Soon only the tips of the flame clouds were visible. Then they disappeared abruptly and it was black night.

The ship swung in line with its orbit again and the professor came back into the observation room. He helped me reload the cameras and change the recording sheets. Then we sat down and ate and waited until it was time to photograph the Sunrise. The motors were roaring at full throttle now and neither of us thought of sleeping.

FOR TWO HOURS we fussed about nervously, hardly speaking. I went into the control room to look at the chart. The black line was following steadily along. The ship was dead on course and if the course was correct, as it seemed to be, everything was just fine.

The professor sat still mostly and didn't look at anything, but I think he was just as nervous as I was. When I told him that the needle was approaching the point where we were to swing vertical again, he practically barked at me.

I went over to the Moonward port and looked out. It was pitch black, the mass of the Moon filling the whole range of vision. I heard Burns get up and go into the control room, so I stood by the cameras. In a moment the floor began to tilt. I started the cameras and watched. An arc of indigo, star-studded sky appeared along one edge of the port and the curved edge of the Moon loomed clear-cut, like a black disk. Intermittent flame tips, that steadily grew in size, danced along the edge. With smooth, deliberate, implacable speed the whole magnificent, brief panorama of a lunar Sunrise swept into view. In a few minutes the Sun filled the whole port, its rays streaming into the cabin. The temperature climbed rapidly. I kept the cameras going till the last possible moment and then closed the port.

The sound of the rocket motors rose to its usual full-throttled roar, as the ship shot directly away from the Moon and gradually swung in a curve toward

the Earth. The lessening of the Moon's gravity could be distinctly felt and in half an hour or so we were back to our own light-inertia gravity.

Burns came back into the room and announced that the ship was dead on course and homeward bound. He seemed vastly pleased with himself and I suppose he was entitled to be. I relaxed. Until I did I hadn't realized that I was keyed up. I sat down, not particularly tired but satisfied and completely at peace, something like the feeling after a risky and particularly successful balloon race.

We reloaded the cameras for the final pictures of our approach to the Earth and then sat down and ate the biggest meal we had eaten since the start of the flight. The professor was more cheerful than I had ever seen him. When we had finished we turned in and, for my part, I slept like a log. Quite happy and contented, we loafed away the return trip and recovered enough nervous energy to negotiate the ticklish business of landing.

As we approached the Earth the ship was swung around until we were traveling stern first. I had not had time to look for the Earth when we had been circling the Moon and now it lay directly astern.

We were approaching the Earth rapidly now, following its rotation. With our rocket power shut off our course was a steep spiral around the Earth and approaching at ever-increasing speed. The ship was still traveling considerably faster than the Earth's rotation, the centrifugal force of this orbit keeping us from falling directly toward the Earth.

I started the cameras and Professor Burns went into the control room to start the rocket motors and slow our orbit until we dropped directly Earthward. The rockets roared to life. We slowed as though we had hit a snow bank. Through the unshuttered port I

saw the whirling haze that was the Earth slowly lessening its speed and finally stop and swing out of sight below our stern, as the ship was balanced to fall stern downward.

We were falling at terrific speed but with the Earth out of sight and no air resistance. It seemed to me, in the insulated cabin, that we were standing still. We fell steadily for a while and then the floor began to press against my feet as the rocket motors were opened up again.

From the control cabin the professor turned on the heater's to warm up the helium and fill the pilot balloon. The top section of the shock-absorbing tube was released and telescoped down inside. The pilot balloon shot out with the main bag snaking out after it in a wide ribbon. It inflated rapidly in the thin air, as the heated helium practically exploded into it. The rocket power was shut off and we continued our descent more slowly.

BURNS came back into the observation room and I asked him how I was to handle the balloon. He told me to follow him. He opened the door and stepped through. I went after him and saw that the whole nose of the ship had slid down the tube until the manhole cover was level with the bottom of the door. I looked up and saw the tight, straining cordage of the balloon. Farther up the balloon itself curved away, completely filling the field of vision.

The warm air flowing out through the open door kept us from freezing and gave us something to breathe in the thin, upper stratosphere for the few moments it took us to lift the manhole cover, unscrew a small plug in it, pass the balloon's valve rope through, climb in and close the cover after us.

We climbed down the rope ladder to the piston, turned on the lights, took the hammocks down and opened a manhole that they had concealed. We climbed

down through this and between the cooling rocket motors. An observation window was cut in the middle of the floor.

Far below I could see the first streaks of misty cloud. The professor drew my attention to a valve wheel and told me it connected with our water supply. I could use it to regulate the ballast. We dropped down and down. The Earth was still obscured by haze. Then, infinitely remote, there loomed an even, gray, flat expanse. It was a relief to see something resembling solidity, even if it was the sea.

We continued on down and the sea began to acquire features. Away to the left a ragged line marked the shore. As I watched I saw that we were slowly drifting toward it. The professor assured me that it was the Alaska coast. I didn't argue with him. As we dropped lower I looked for signs of life, but there wasn't a piece of shipping on the whole vast expanse of water spread out below us. We were low enough now to see the mountaintops along the shore line and the valleys creased between them. I didn't recognize any of it. Somewhat against my better reason I had been looking for our lake, but there was no sign of it. Then I remembered it had been drained.

As soon as I stopped looking for a lake and hunted around for an empty crater it was easy. There was only one in sight. After I picked it out I recognized the contour of the surrounding mountains and, believe me, that nightmare of wrinkled Earth certainly looked good. We were falling more slowly now—too slowly, so I valved a little gas. A small breeze picked us up and carried us straight inshore toward the crater. I released more gas and then some more. We were falling too fast, but at that it looked as if we would pass the crater. Then the breeze died away. I shot out ballast. We slowed a little and didn't drop so vertically.

I couldn't see much from the bottom

window now, so the professor opened a servicing port between two of the rocket tubes and I conned the ship from there. I saw we were coming in lower than the edge of the crater, so I spun the ballast valve wide open. We started to rise slowly, but our huge equipment did not respond enough. The stern of the ship smashed against the edge of the crater and the nose heeled inward.

I yanked the balloon rip cord. The nose began to drop toward the center of the crater, faster and faster. The ship landed on its side—with a crash that threw us all over the tiny stern cabin—and then skidded down into the bottom, crushing its nose against the concrete shaft.

SLIGHTLY DAZED, I picked myself up just in time to see the professor scrambling through the manhole on his way to inspect the damage in the observation room. I followed him down the tube, through the top manhole and into the room. Two of the cameras had been wrenched loose and had wrecked quite a lot of the more delicate instruments.

Burns was busy salvaging the films and the record sheets. Luckily, these were all intact. I picked up an armful of film boxes and went back up the tube with them. I got to the service port and was looking for something soft to throw the boxes out onto when I heard some one sliding down the side of the crater.

It was the Swede. He came up, shook hands and asked me where the professor was. I told him he was inside getting some more films and stuff, gave him the ones I had and went back for another load. The Swede started up the side of the crater and, just as I went back, I heard two or three more of the men coming down.

When we finally got the last of the stuff out of the crater several loads had already been carried down to the head of the elevator shaft.



We shifted it all down to the seaway and stacked it on the float where the professor's thirty-foot cruiser was tied up. By the time we finished the job it was getting dark outside. I felt hungry and the rest of the men looked it so we decided to eat, turn in for the night and load the boat in the morning.

WE WERE in the mess hall behind the office eating supper when we received the first intimation of disaster. It consisted of a violent tremblor, followed by a huge fragment of rock that crashed through the table, killing two of the men instantly.

With a deafening roar the whole rear of the room converted itself into a tumbling heap of broken rubble and all the walls began to run down like banks of loose gravel. I was out through the office and down to the seaway in about three jumps I think, with Burns and the Swede about twenty yards behind me. We were the only ones that left that room.

I jumped down on to the float, cast off the painter, turned on the switch and stepped on the starter. The roar of the starting motor was completely lost in the titanic thunder of falling rock. I leaped back to the trail to see how the others were doing. A screaming gale was tearing along the seaway. It was like the blast from an open furnace door, so hot that it blistered my face and hands. I looked into the wind with smarting, streaming eyes.

The Swede and Burns were staggering all over the trail and seemed to be miles away, struggling toward me with painful slowness, like figures in a nightmare. I saw Burns open his mouth as though to shout, but I was long past

hearing anything less than a broadside. For one instant they struggled there and the next they vanished in a roaring sheet of white-hot flame.

The hot blast lifted me high into the air. I fell for an age-long moment and crashed down across the thwart of the boat. I guess that's what broke my back. A hint like that was a bit too pointed to be ignored. I couldn't move my legs but I could reach the clutch with my hand. I released it and let it slam in. Then I hung onto the wheel.

The boat tore down the seaway. If it had been anything but straight I would never have got through. A stifling cloud of smoke and flame chased me all the way and the collapsing tunnel seemed to be closing down just about ten feet behind my stern.

I was only half conscious most of the time and when, at last, I burst out into bright Moonlight I blacked out. The next thing I knew I was being hoisted on board a coast-guard boat. I guess you know about all the rest. All I've told you is true, but I can only tell you that; I haven't any way to prove it. You might find some remains around the volcano and there's the boat, too. You'll find that it was registered in Professor Burns' name. I don't seem to be able to care much, though, whether it's believed or not.

LEE BARON didn't have much reason to care what we earthbound mortals chose to believe. When I left him, after he had finished his story, it wasn't long before he started on a journey from which he will never return to give us even the briefest account of what would likely prove to be even more unbelievable adventures.

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## SEEKER OF TO-MORROW

by Eric Frank Russell and Leslie T. Johnson

*will appear in the July issue of Astounding Stories.*

# Cosmic Discovery

## *A study of the Solar System*

Article No. 13 by John W. Campbell, Jr.

WHEN Herschel first observed Uranus, you will remember, he discovered it was a member of the solar system, and reported it to the Royal Society as a comet. That planets unknown to the scientists of the ancient world could exist, and did exist, was a theory held by a number of men, but it was not held by the sound thinkers of the day. They had no legitimate reason to think so, no basis for such a belief. Those who did consider that planets beyond Saturn really existed were not "ahead of their day"; they were wishers. They hoped there were planets, but had no reason whatever to believe there were.

Since Herschel's day, Neptune and Pluto have been discovered. The discovery of Uranus had opened to the scientific world a new field of endeavor; the discovery of new planets. For, having found one, it gave logical reason to believe that there might be still more undiscovered. The discovery of further worlds ceased to be the vain daydreams of a night-prowling astronomer; it now had scientific, orderly thought behind it.

Two more have been discovered? Are there yet more worlds beyond these worlds? Can we, will we, in the next decade or so discover another world, lost now in the blazing sheet of stars the heavens display?

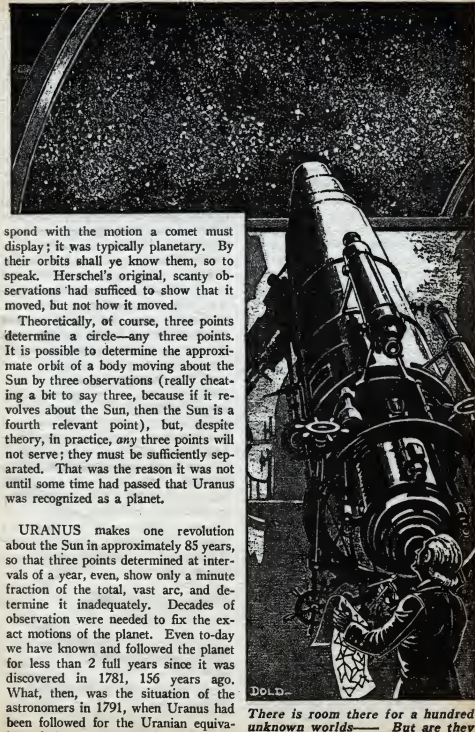
It is impossible to say with absolute assurance that we won't, because any searcher of the skies may stumble on one. That planets more distant than Pluto may exist is unquestionable; the Sun's gravitational control rules space

rigidly for a distance certainly ten times greater than the radius of Pluto's orbit. Probably it could maintain effective control at a distance one hundred times as great. Some of the long-period comets must retire to those immense distances, perhaps wavering in the farthest, uncertain fringes of the Sun's "sphere of influence," where cross pulls of Proxima Centaura and the more distant stars make the orbits hesitate.

There is room there for a hundred unknown worlds. They *could* be there. But are they? Have we any reason, not mere guess, to believe there *are*?

It is in connection with these questions, perhaps, that the seemingly similar, but actually widely differing stories of the discoveries of the two outermost known planets are most interesting. Both these planets were found by intention, not blundering fate, or obvious brilliance in the skies, and in this they are unique. Yet, though both were found by logic, each case typified one of the two possible means of planetary search: mathematical research, and planned, patient, persistent mapping of the heavens.

Uranus was, in more sense than one, the key to the question of further planets. Primarily, it gave reason to believe they existed, and, secondarily, it gave proof that Neptune existed even before it was found. Herschel's original announcement of the discovery of a "comet" was proven wrong, because, on continuing observations of the new body, it was soon evident that the slow movement of the object did not corre-



spond with the motion a comet must display; it was typically planetary. By their orbits shall ye know them, so to speak. Herschel's original, scanty observations had sufficed to show that it moved, but not how it moved.

Theoretically, of course, three points determine a circle—any three points. It is possible to determine the approximate orbit of a body moving about the Sun by three observations (really cheating a bit to say three, because if it revolves about the Sun, then the Sun is a fourth relevant point), but, despite theory, in practice, *any* three points will not serve; they must be sufficiently separated. That was the reason it was not until some time had passed that Uranus was recognized as a planet.

URANUS makes one revolution about the Sun in approximately 85 years, so that three points determined at intervals of a year, even, show only a minute fraction of the total, vast arc, and determine it inadequately. Decades of observation were needed to fix the exact motions of the planet. Even to-day we have known and followed the planet for less than 2 full years since it was discovered in 1781, 156 years ago. What, then, was the situation of the astronomers in 1791, when Uranus had been followed for the Uranian equivalent of about a month and a half?

DOLD-

*There is room there for a hundred unknown worlds— But are they there?*

Evidently their data would have been highly erratic, but for one thing: Many astronomers before Herschel had seen that telescopically brilliant body, but had always recorded it as a star, in drawing up their star maps. They located this "star," and carefully put a small point on their maps (all done laboriously by hand) for the benefit of future researchers. There were no photo-engraving processes in those days, and copying those delicately drawn maps was far beyond the ordinary printer: They had a very, very limited circulation, else Uranus would have been found before.

But, once found, those maps were immediately consulted. "Why didn't old So-and-so record this planet? He examined that area——" Knowing the approximate orbit, it was easy to say that it should have been just about *there* in 1720, for example, and examine the maps of 1720. When they did find it, and on another map of, say, 1760, they had three points in its orbit covering more than a whole revolution. That should fix the orbit accurately.

But now a new factor enters into the problem. Neptune, as yet undiscovered, was out there in space, more massive and larger than Uranus itself. (Neptune is 31,000 miles in diameter—17.16 times as massive as Earth; Uranus is 30,000 miles in diameter and 14.7 times as massive as Earth.) Those old observations and the observations made in the 1780s were used to draw up tables of the planet's motions. But observations made through the years, in 1780—1790—1800, began to disagree with the predicted values. The blamed planet "warn't whar it orter bin," so to speak. By 1820 there was no question about the discrepancies; they were, to astronomers, huge. Their existence could not be denied.

Three things were possible: first, that the old observations made when Uranus was thought to be a star, were in error. They were made years ago, when the

telescopes were less perfect (thought the astronomers of 1820) and, further, they didn't know the old records were made carefully, while they knew very well that they had worked hard over the observations they themselves had made. Furthermore this hypothesis was attractive, because it was the old observations (since they gave the greatest separation of points, and hence fixed the orbit more rigidly) which had the greatest influence on the calculations. Dropping them eliminated the errors fairly well. But to do so meant accusing the old observers of brutal error.

The second possibility was even more distasteful: Newton's law might be wrong. Gravity had never been proven at such immense distances. It had been known that Saturn was not quite obeying the law for many years (due to the then undiscovered Uranus) and though this had been accounted for now, for the most part, there still remained some irregularity, and there was this new and greater irregularity of Uranus.

Was Newton wrong? His formula read  $F=G Mm/d^2$ , but suppose he were wrong to this extent, that the exponent should have been not 2 but 2.0000001 or 1.999999, for instance. Those minute differences would become mighty when applied to billions of miles. Perhaps values that had not been suspected lay in that. The possibility made it even more vitally necessary that the irregularity be accounted for; lest they find that their whole structure was at fault at the very root.\*

\* The idea of the fractional exponents is not at all far from the truth, and indeed may be said to be the present theory. It will be remembered that the orbit of Mercury advances in a manner not wholly accounted for by Newton's law of gravity, but explained almost entirely by Einstein's law of gravity. However, Einstein's law does not account for a small residual discrepancy, and, further, does not account for small motions of Venus, Earth's, and Mars' orbits. Using a fractional exponent in Newton's law accounts for these motions better, but fails to explain other things. On the other hand, remember that the square term in most physical laws arises from the theory of conic sections. But Einstein proposes a space in which neither straight-line-sided cone, nor plane is possible. Hence, in effect, the exponent cannot be 2, but must have some other value.

The third explanation conceivable was the possibility of a new and undiscovered planet. This idea was by far the most interesting and pleasing, but it was not without its thorny side. By 1820 it was a very much sought-for world, and various people had suggested trying to find it by calculation, working back from observed effects produced on Uranus.

Sir George Airy, astronomer royal of England, and a man who should have known if any one should, declared later than 1840 that the mathematical problem of predicting the unknown planet's position could not be solved. But the errors in Uranus' position by 1840 were intolerable. (They amounted actually to an angular distance about  $\frac{2}{3}$  as great as the smallest angle detectable to the unaided eye.)

WHAT CHANCES had they for locating that (or, for that matter, have we for locating any other) unknown planet? There are two available methods: the Adams-Leverrier method and the Columbus method. The latter is the hunt-and-discover system, and while it worked for Uranus, the problem was different with Neptune and, of course, Pluto.

Neptune is entirely beyond the range of human vision—much too faint. Today, it would be possible to discover it fairly readily by photographic star mapping, which makes it possible to map a whole region of the heavens accurately, beyond question, in a single evening. At that time every star had to be marked by human eye and human hand.

Furthermore, since it was so faint, a large magnification was needed to see it. Say you needed a tenfold magnification. Then, in the first place, there would be ten times as great an area to map—because you have magnified not only Neptune but all the heavens as well. And, worse yet, the magnification that brings Neptune into view, brings also an im-

mense number of stars which must all be mapped. And here the factor is not 10, but an even greater number. There are approximately 2,000 stars of the 6th magnitude, the brightness of Uranus. But there are 27,000 stars visible when 10 times the optical power is used. Pluto needs about all the optical power available for any real observation. By that time 890,000,000 stars are visible. The thing gets out of control.

To find Neptune by direct search would have required 2 complete mappings, each showing every body within reach of the maximum optical power. 2 were needed, made at different times, in order that motion of the planet during the interval might be detected. Each of the tens of thousands of bodies would have to be observed and pointed on the finished work by laborious manual operation, in that day before photography.

Finally, if the entire, immense labor were done, the 2 maps would have to be searched with utmost accuracy, each of the thousands of points being separately compared. If, even after this, no body were found that indicated a planetary motion, that would be negative proof; it would mean only that no planet detectable in their optical apparatus existed. It would not mean that no planet existed.

That left the mathematical analysis as the only practicable hope. But—was it practicable? Sir George Airy said it was not. He had reason to. In solving a geometrical problem the proposition usually starts off something like this: A equals B, and Angle C equals B; to find—or to prove— But always, Given:— But—nature wasn't giving a thing. Probably the planet was in the plane of the ecliptic, the same plane that all the other planetary orbits lay in. But—how far out? Was the orbit circular, like the profile of an egg, or like the profile of a dirigible? What was the mass of the planet? Was it an unsuspected giant, like Jupiter, 300 or more times as



massive as Earth, and very distant, or a light planet, perhaps no larger than Earth, and comparatively close? Both might have the same effects. Not quite, because the big, massive planet, very distant, would have a longer year than the smaller, nearer planet. But—to detect this a period of something like 200 Earth years would be needed.

That greater time had really been needed was indicated by the final, brilliant work of Adams, of Cambridge, England, and of Leverrier, of Paris—2 comparatively young men who, independently, solved the problem with sufficient accuracy to locate the planet. (Their results agreed to within one part in 300, and the planet was within one part in 300 of their results.) Leverrier assumed the new planet to be more massive than Neptune actually is, and that it was at a greater average distance from the Sun. But—his mathematics was very sound; the errors canceled somewhat, because he also assumed an egg-shaped orbit, and that Neptune was, at the time of the work—1846—at or near perihelion, and hence actually nearer the Sun than his average distance. The result was that his distance-at-the-time and the actual distance came out pretty close. Had he had observations of Uranus extending over 200 years, he would have seen at once that the average distance of Neptune was less than he had assumed.

NOW, about further planets? Pluto is an excellent answer, for though the story of the discovery of Pluto and the history of Neptune's discovery seem very similar on the surface, they are not. Neptune was definitely discovered by mathematical reasoning based on known facts and a sprinkling of assumptions. There certainly was no question about the vagaries of Uranus' motion.

But Pluto was not discovered as a result of mathematical calculations. It was obvious that, as Neptune had been

discovered by mathematical research, others would attempt to similarly locate trans-Neptunian planets. Of all those who tried, Percival Lowell made the most thorough investigation of all pertinent data.

Remember this, however, in considering the problem; in general, the planets taper off at both ends, so to speak. From Mercury to Jupiter they increase in size fairly regularly, the one exception being Mars; and from Jupiter out they dwindle, Saturn smaller than Jupiter, Uranus and Neptune smaller than Saturn, and about equal in size, Pluto smaller yet. But Jupiter is 340,000,000 miles beyond Mars, Saturn 400,000,000 miles beyond Jupiter. And then, suddenly, 800,000,000 miles more to Uranus, a round billion to Neptune, and nearly another billion to Pluto. Pluto is farther from its nearest known neighbor, then, than Saturn, the most distant of the anciently known planets, is from the Sun. The distances have become swollen, bloated figures, beyond our comprehension. Gravity, meanwhile, weakens as the square of the distance increases (and a billion squared is 1,000,000,000,000,000), while the planets are growing lighter. The effects to be detected are growing rapidly fainter.

Further, century on century must elapse before Neptune and Pluto are twice in conjunction at their nearest approaches. With infinite slowness, Neptune creeps ahead of Pluto in its vast sweep. 164 years elapse before Neptune makes one sweep. 250 years pass before Pluto makes one, and then Neptune is only about half a lap ahead of Pluto. It must make another complete lap before conjunction occurs once more, and maximum effects are visible. Meanwhile, Uranus and Saturn have several times tugged on Neptune as they rushed past.

Actually, with only about 80 years (half a Neptunian year) of observations

on which to base his calculations, Lowell's figures could not be accurate. They were not, and his mathematical planning was a work of genius, frustrated by a lack of data. But he laid another plan. Lowell discovered Pluto, even after his own death, by the plan he had laid. Wide-angle telescopic pictures mapped the whole region of the sky where the planet might be. Stars do not move; but even Pluto must move slowly. Between two photographs of the same region, taken at different times, motion existed. By projecting the two plates alternately in rapid succession, the same effect that makes the movie projector possible came to the aid of the searchers. The motionless stars remained unchanged, whether viewed singly, or in this flicker projector. Pluto, however, jumped and wavered. It was the effect of a super-super-high-speed movie. Pluto's creep was amplified a million times to a darting race.

Lowell had calculated the effects produced by a hypothetical planet unsuccessfully. The reasons are obvious; mathematical inquiry breaks down hopelessly without data. There simply are not enough data. Pluto was found not by the logic of mathematics, but by the logic of planned persistence.

THEN, evidently, no trans-Plutonian planet can be found by mathematical logic, for the same reasons. It must be still more remote, its effects still more slow to manifest themselves. It is prob-

ably a pretty safe statement to say that no planet will be found beyond Pluto by mathematical prediction until a period of 500 years or so has elapsed, permitting the gravitational disturbances to accumulate, and accurate plots of Neptune and Pluto to be made.

The effects Lowell had calculated on, in assuming his hypothetical planet, had not permitted him to find Pluto, for Pluto did not at all fulfill the specifications he suggested. It was much, much too small to produce the changes in other bodies from which Lowell had worked. It was not exactly where he had said it should be (though this meant less). The great point was that unless the planet is, most improbably, dense, it cannot possibly be the object that Lowell's mathematics referred to. And it is considerably nearer than Lowell's hypothetical planet.

It will be a fearful task to find yet more distant planets. We do not even know that the laborious search would be repaid by a discovery; it may be that Pluto is the last, the ultimate planet of the solar system. There must be a limit somewhere; perhaps Pluto is that limit.

Remember this though; Percival Lowell was no fool. He worked for years gathering and selecting data, calculating, trying to predict the unknown position of an unknown planet. When, years later, Pluto was found, it became evident that, for all his careful study, the data did not apply to the new planet.

To what, then, *did* they apply?

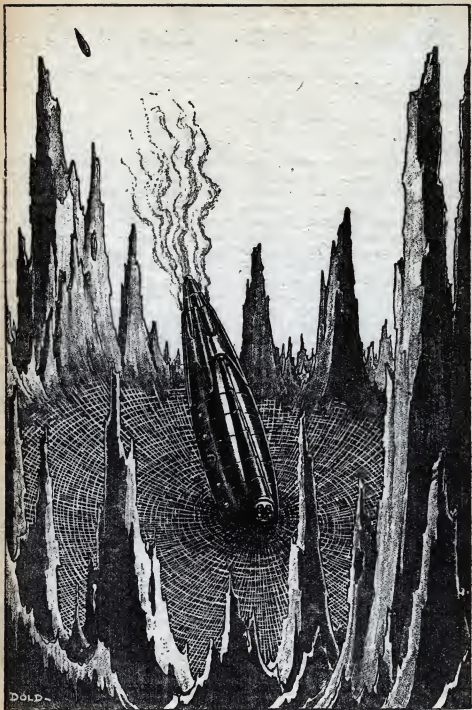
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Next Month:

## Interplanetary Dividends

*Article No. 14 in the study of the Solar System*

by John W. Campbell, Jr.



*The web curtain of interlocked electromagnetic waves was but in its crude beginning back on Earth. Here, however—*

# When Time Stood Still

*A sequel to "Nova In Messier 33"*

by Chan Corbett

**H**ER LINEAMENTS were faded and tarnished with an incredible antiquity, but Jon Wayn, man of the ninety-ninth century, found them superlatively beautiful. The picture was flat, two-dimensional, crudely deposited on a glassy substance, iridescent with age and sprayed with the fine cracklings of disintegration; yet through the overlaying mists of time, in spite of the queer garments and type of headgear, Jon's blood stirred with an unfathomable emotion, so strong, so alien to the cool intellectualism of the year 9876 A. D. that he was sorely tempted to destroy at once the seductive representation and look no further.

Nevertheless, he did not. She was beautiful—this girl of a forgotten time, whose eyes stared back frankly into his own across the tremendous gulf of years, beautiful in a way that no longer inhered in the women of his own day and age. He had never felt the lack before, having no standards of comparison. Now he had—with a girl who had died under strange circumstances almost eight thousand years before, in an era of primitive races and semisavage groping.

Hesitantly, almost reverently, he showed the picture to his friend, Dore Allyn. "What do you think of her?" he asked.

They were within the light-guarded vault of the Wayns, which none but Jon could have opened on the death of his father. The vigilant photo-electric cell scanned the features of the young heir as he presented himself within the focus

of the inspection beam, swung the neutron panels open in token of satisfaction. Jon had entered, with Dore as companion, curious as to the contents of the carefully sealed chamber of which his father had spoken but once, and then only on his deathbed.

To say that he had been at first disappointed was putting it mildly. The vault, its walls glowing with eternal cold light, was tenantless except for a tiny beryllium box. Another photo-electric cell scanned his features before it yielded its treasure. This treasure was—the ancient, discolored likeness of a girl, bizarre in lineament and depiction.

Jon had given her scarcely a glance at first. For with the plate were deposited thin metal sheets, on which a crabbed, outlandish text was graved, still legible against the sweep of time. It was with difficulty that Jon deciphered the meaning. Though English in a sense, it was archaic in form and lettering, and diffusely circumlocutory to a modern world where swift compressions were the soul of wit, but Jon, with Dore's help, stumbled through.

It told an incredible, fantastic story—the story of one John Wayne.

"Why, that's an archaic variant of your own name, Jon," Dore had exclaimed, "a scientist of a remote twentieth century. He had, it seemed, been present at the vanishment of the Moon, when a nova in Messier 33 had burned through subspace and formed a pressure beam which condensed electron orbits to incalculable densities and thereby in-

folded the Moon in a space circuit of its own contriving."

That much had been known to Jon and Dore. The Great War of 2168 and its temporary eclipse of civilization had not completely obliterated all vestiges of former science and knowledge. The story of the silver satellite had come down through the ages. The tides now rose and fell a mere sluggish foot or two—the nights were dark with the faint pricklings of innumerable stars, and Earthly matter weighed a trifle more than theretofore—but the men of 9876, being intellectuals, did not feel the lack of that romantic glamour which in earlier and more primitive times had been inevitably associated with the lunar orb.

But the second part of John Wayne's story was new. It told of a great city called New York, which had teemed with millions of people on the shores of the Atlantic. It told, with a sudden access of authentic emotion that throbbed and delivered its message even across the centuries and through the crabbed, archaic elder speech, of a young girl whose name was Betty Middleton, with whom this ancient John Wayne had obviously been in love. She had, it seemed, for purposes unknown, gone to this elder city of New York, had there been trapped, along with ten million others, when the subspace beam from Messier 33 impinged on a thin segment of Earth's surface.

ACROSS the long gulf of years came the thrill of John Wayne's frantic dash across the continent to warn the fated people and rescue his beloved. He had failed. The stilted, curiously worded phrases of the textbook took on a certain glow as he narrated his vision of the doomed Earth segment, of towers and busy streets and girdling rivers shrinking to nothingness in a fierce green blaze, of the swift warp of space time around the dense-packed electron orbits, of their vanishment from human sight.

He, John Wayne, had been traveling with two companions in a clumsy, incredibly slow machine called an airplane. The plane had crashed to Earth: His companions had been killed, but John Wayne had survived, albeit crippled for life. He had, and the pathos still lingered in the blurred gravures, devoted his remaining years to desperate attempts to discover some principle whereby the trapped millions—and Betty Middleton—might be retrieved from the horrible doom which had enveloped them.

The years passed unavailingly; the scientists of the world added their efforts; John Wayne grew old and gray, his tortured limbs giving him no surcease, his indomitable spirit flaming through bodily ills; but nothing could be done. Without doubt, Betty Middleton, and all New York, were dead long years, for even if they had somehow survived the strange condensation, the vanished segment held neither air nor food supply, nor the wherewithal of replenishment sufficient for more than a mere month of days.

Nevertheless, John Wayne refused to relax his unremitting research. He did more. As the normal span of his own tortured life approached its end, he married—deliberately—and with full awareness on the part of his wife as to his purpose—so that the child of his loins might take up the task when perforce his lifeless hands must let it drop, and continue the long search for the key which would unlock the incredible prison in which New York was immured.

A son had been born, named as he, John Wayne. To this son, before he died, old Wayne had bequeathed this heritage—the long story, engraved on durable metal, and the picture of the girl he had loved with such passionate devotion deposited on immortal substance. For, he ended pathetically, once he had had a premonition, and it had come to pass. Now he had another:



that many generations of John Waynes would live and die and bear their sons, before success would crown their efforts. Therefore, he, John Wayne, progenitor of a long posterity, laid solemn compacts upon the future that each elder son, in turn, be called John Wayne, that each, in turn, must, on receipt of this bequeathment from the past, devote his life, his science, his energies, to the unsealing of the infinitesimal, vanished tomb that once had been a mighty city.

## II

THE STORY stirred Jon Wayn. Eight thousand years had passed, and still the tribe of John Wayne had remained intact through fantastic vicissitudes, and still they heeded and obeyed the injunction laid upon them by a monomaniac ancestor. For had not his father, the elder Jon, been chief of the scientific council ever since he could remember; had there not been murmurings among the elders at his strange preoccupation with secret pursuits in his remote laboratory on Phobos, tiny satellite of Mars?

Yet such had been the power of his father that the elder scientists, who ruled Earth and all its tributary planets, had murmured, it is true, at such secreted research, yet had perforce acquiesced. All, that is, except the youngest of the elders, black-bearded, glowering Belor Grame; he who, by a sort of *coup d'état*, had wrested leadership in old Jon Wayn's place from a reluctant council of scientists.

But if the story had moved young Jon, the faded picture had brought strange, hammering emotions. "What do you think of her?" he asked Dore Allyn.

Dore glanced indifferently at the girl. "Obviously a creature low in the scale of evolution," he answered casually. "Rather ugly, if the truth must be told. Nothing like our modern women. Take

Lisa Wilse, for example. Now *there* is a beautiful girl. Nose of most generous size, high, bulging forehead that denotes capacity for intellectualism beneath, skull remarkably smooth and hairless; not, as in this creature, covered with unsightly hirsute locks, like an animal that requires protection against the elements."

Jon snatched at the precious plate with a savage vehemence. "Give it back to me!" he cried. His voice was queerly choked, a mist of anger veiled his eyes.

"Jon! What's the matter?" Dore's surprised voice brought him to his senses. In the world of the ninety-ninth century there was no room for such uncouth emotions as he had just displayed. He was ashamed of himself, yet filled with a strange joy. Not yet was he to know that he had fallen in love with a faded picture—a representation of a girl who had died eight millenia before, whose very elements had been ravished from the universe of space time in which he existed. Love was a forgotten ecstasy—one that had been bred out of the race several thousand years before, in favor of eugenic, coldly scientific mating.

"Sorry!" he muttered. "It's just a difference of opinion, and I shouldn't have shouted. But there is no woman living to-day, or, for that matter, has ever lived who could possibly be as beautiful in form and feature as this Betty Middleton whom my ancestor loved. Even the elements you find to be marks of ugliness to me are crowning glories. That long, wavy hair, that pert, delicate nose, that slightly retreating forehead, seem to me somehow more gracious than the pronounced features, the baldness of the women of our own times. The latter are intellectual, it is true, but beauty is something else."

"Ah!" said Dore significantly, and, being a friend, said no more.

But the tone was sufficient to bring a flush to young Jon's cheek. For Jon

himself was blessed with rather more hair on his head and more regularity of countenance than was common in the ninety-ninth century. Had old John Wayne transmitted his own picture to posterity, the resemblance between the pair might have been considered remarkably striking.

Young Jon hastily replaced the plate and the graven legend within the beryllium box. A soft whirl and it closed.

"A very pretty, if long-winded, story," declared Dore. "What, if anything, do you intend doing about it?"

"Do?" Jon straightened up; his lips compressed. "Why, what else is there for me to do but carry on?"

Dore stared at him curiously. "But that is ridiculous," he protested. "A profitless, arid research to discover a long-disintegrated city simply because a primitive ancestor so decided. Remember how it got your father into trouble. If the council hadn't feared his iron will they would have deposed him, have shunted him to the prison planet for irregularity of conduct long ago. Even now your future niche is being considered, and your eugenic number is in the mating machine."

JON'S BROWS pulled together; his jaw became square. Had Dore but known it, the resemblance to that primitive ancestor he had derided was stronger than ever. "I won't—" started Jon grimly, and stopped. For the disk on his right wrist gave warning signal. Some one was calling his specific wave length. Jon flicked contact, and a voice rose up at him.

"Jon Wayn, Eugenic Number A5369! This is Belor Grame, chief of the scientific council. You are to report to the council chamber at once for assignment to your life vocation and for betrothal to your eugenic mate, Lisa Wilse, B64012. Please be prompt!"

The voice faded and died with a little click, but Jon Wayn stared at the

tiny disk as if it still reverberated with the accents of doom. Lisa Wilse! Lisa, whom Dore Allyn had just described as his ideal of beauty; Lisa, whom Jon deemed as lovely as any female could be. Now a shudder of revulsion coursed through his being. Suddenly that smoothly bald head, that protruding forehead and curving nose, erstwhile symbols of charm, had become repulsive, ugly. The lineaments of a girl, infinitely remote in time and space alike, rose in their place, filled the universe with their piquancy.

"Congratulations!" said Dore cordially, all unwitting. "I confess I had hoped the mating machine would decide on myself as the proper mate for the lovely Lisa, but I am glad for your sake, Jon. As for your life vocation, no doubt the sub-conclave of Psychoanalysts have decided on something fitting to your abilities and powers. When my turn comes—"

A strange look crept into young Jon's eyes. It hardened. "I won't do it," he said tonelessly. "I won't mate with Lisa, and I won't submit to the council's plans for my life work."

Dore gazed at him incredulously. "Have you gone mad?" he cried. "The mating machine is infallible; the conclave of phychoanalysts almost as unerring. Besides, do you realize what you are saying? You are presuming to set your puny will against the decree of the elders!"

"I know it," Jon said simply.

"But—but—" Dore spluttered. "It's impossible. It just isn't done!" He was bewildered, alarmed. In the ninety-ninth century only a few—extremely rare products of mistaken matings by the machine—had dared rebel by word or deed against the fiat of the council. And they were even now expiating their crime on the dun ice world of the prison planet.

"It's not impossible, and there must

always be a first time," Jon argued reasonably.

"But the council will send you in fetters to the prison planet."

"If they can catch me."

Dore was shocked. "Idiot!" he cried. "Where in all the universe do you expect to find shelter against the power of the council?"

"On Phobos, the laboratory of my father," Jon answered promptly. "He told me things before he died. I did not quite understand at the time. Now I do. He must have foreseen."

The signal on Jon's wrist buzzed warningly. He looked down at the disk with a grim smile. "Belor Grame is getting impatient. Obviously he has some especially attractive destiny marked out for me. In any event, there's little time to lose. If I don't get started soon—"

Precious beryllium casket under his arm, he hurried out of the vault. The cell-operated door swung impenetrably shut behind them. A two-seater monocoar stood outside, capable of two hundred miles on land, five hundred miles in the air, and a hundred on water. Jon swung rapidly into the pilot's seat, started the controls. There was no engine, no motor, no noise. Its propelling power was light-beam radio energy broadcast from central atomic plants. The signal kept on buzzing.

### III.

AS THE CRAFT started away, Dore Allyn took a running jump, landed breathlessly in the seat beside Jon. His friend looked at him in surprise. "It would have been wiser," Jon said, "for you not to be seen with me. Belor Grame will ask questions when he finds me gone."

"You're a fool," Dore growled, "an idiot of a primitive, romantic type. That's why I'm going along to keep you company. You need protection."

"But you can't do that," Jon protested. "It means outlawry, cutting yourself off from everything you wanted."

Dore looked back. "It's too late now to do anything about it. I see a patrol car taking off from the roof of the hall of the scientists. Belor Grame's sending a guard of honor to escort the reluctant swain to his bride and to his duties."

Jon swore sharply, jerked his controls to the last notch. He'd barely have time to make it.

Beneath flashed the white-and-gold towers of the city of the scientists, capital of the solar system. Within their ornate precincts the scientists, a select caste, rigorously controlled on hereditary and eugenic principles, delved into the secrets of nature, ruled all the planets through their self-perpetuating council of elders. Outside their ranks, the common herd, here on Earth and colonizers on Mars, Venus and the moons of Jupiter, teemed submissively and tended the great machine cities.

The wind of their swift flight streamed past them at five hundred miles per hour. "Where are we going?" Dore demanded. Behind them, the patrol had nosed down to the entrance to old Wayn's vault. Guards, in the silver uniforms of the council, were on the ground, trying vainly to force the neutron walls.

"To our space hangar," Jon said. "I had a premonition I might need the *Comet* in a hurry. She's already loaded with supplies and fuel, ready to take off. She's the fastest space craft in the system; my father didn't report everything he discovered in the Phobos laboratory."

"She'd better be fast," Dore remarked in a conversational tone. "The patrol plane has picked up our trail, is taking off after us."

"We'll show them a clean pair of rocketing tails," Jon answered confidently.

And they did. The Wayn space

hangar was on the outskirts of the city. The small, compact flier, shaped like a falling teardrop, gleaming like a silvered mirror, poised on its rocket pit, nose pointed to the zenith. It was the work of seconds to trundle the two-seater to a halt before the space ship, the matter of a minute to dive from its cushions

into the yawning port of the *Comet*, to swing it smoothly shut behind.

Jon leaped for the instrument board. There was a soft, roaring sound; and the *Comet* swooshed upward into space like a thoroughbred. The patrol plane, coming along fast at the thousand-foot altitude, swerved violently to avoid the



*The patrol planes swerved violently to avoid the rush of blazing gases—*

rush of blazing gases, turned back disgruntled to report and raise the alarm. By that time the *Comet* was clear of Earth's atmosphere and picking up acceleration.

"They'll radio the space cruisers," Dore remarked cheerfully.

Jon did not even look up from the

plotting board on which he was laying out their course. "Let them," he said. "There isn't a cruiser can catch us. And once on Phobos——"

THEY made the tiny satellite of Mars in six days, averaging a hundred miles per second. Fortunately Mars



"They'll radio the space cruisers," Dore remarked cheerfully.



was then in conjunction with Earth. Far behind, hopelessly so, lumbered the council cruiser that had been ordered into space to catch the runaways.

Dore cocked an eye at the visor screen. Phobos, the inner satellite of the red planet, was a small grayish ball directly ahead. Its whole diameter is not more than twenty miles, and its surface irregular, lifeless rock. No air existed on the tiny sphere. Slightly to one side, however, Mars reared its glowing convexity to fill almost a quadrant of the heavens. From the valley city of Bilosyrtis a streak of orange red curved upward. Behind them, in the direction of Earth, the cruiser lumbered on, two days in the rear.

"The Martian patrol just took off," grunted Dore. "Where do we land?"

Jon did not reply. He was too busy at the controls. The silver *Comet* jockeyed down in cushioning jets of flame until it hovered over the whirling, speedy satellite. Directly beneath, turning even as they dived, was a smooth segment of shimmering web curtain stretching between two jagged crags.

Dore stared at it through the view-scope, fascinated. The web curtain of interlocked electromagnetic waves was but in its crude beginnings back on Earth. Here, however—

It seemed to dissolve as Jon pressed a button. Their craft sank slowly through it to an artificial tarmac beside a group of buildings. A deep, smooth-bored hole snouted up at them like a threatening space gun. Then they were landed. And overhead, the web curtain had swung into position again, shimmering, transparent—so that they could see the Martian cruiser hovering vainly overhead—yet so impregnable that neither atomite bombs nor blue rays nor neutron bolts could make the slightest dent in its impalpable weave.

This, then, was the secret laboratory of old Jon Wayn, late chief of the scientific council.

"You've been here before?" Dore asked.

"Yes, about six months ago. Poor father must have anticipated he was soon to die. He explained everything to me, all the new ideas he had brought to fruition in this place. But he was secretive about two things: one was the story of his ancestor and the lost city of New York; the other his reason for hiding his scientific results from his fellows. Perhaps he was afraid to place such tremendous power in the hands of the council. They were at loggerheads all through his term. He held certain ancient views on democracy and freedom of opportunity for the masses as against the closed caste of the scientists. They outvoted him on every point."

Dore shrugged his shoulders. This was too much for him. But Jon was his friend, and he was entitled to his wild talk. And he didn't care particularly for Belor Grame, the new head of the council of elders.

Overhead the space cruiser still hovered. It was signaling. First by radio, but the waves beat back from the web curtain. Then by code light beams.

Dore read them, grinned a bit anxiously. "Wants us to surrender, in the name of the council, or take the consequences."

"Bring on your consequences," Jon signaled back gayly. They had gone into the main laboratory, where the complexity of apparatus bewildered Dore, accustomed as he was to scientific tools.

THE CONSEQUENCES came in a hurry. Two atomite bombs blurted down. They smacked into the impalpable web curtain, detonated into a fury of roaring, flaming energy. But the shimmering wall of force held intact. The cruiser tried other weapons without success. In disgust it swung back to the gigantic loom of Mars.

"We're here, and we're safe momen-

tarily," Dore said wryly. "But just what do you expect to accomplish?"

Jon barely took time out for words. Already he was busy, manipulating apparatus, tightening, calculating, testing. "Last time I was here, my father told me he was almost ready for some crucial experiment. On his deathbed he went further. He was ready, he declared. He had forged the final link into the long, ancestral chain. Then he died before he could explain further."

"In two Earth days," declared Dore skeptically, "we'll be ringed in by the fleets of the council."

"In two Phobos days," retorted Jon, "I'll have either restored New York or brought to countless generations an end of ceaseless toil."

Dore made a gesture of irritation. "I still say," he cried, "that it would be better to let this primitive city remain where it is. What will you find? The impalpable dust of a people who had starved and suffocated to death eight thousand years ago. It's sacrilege, in a way."

A spasm of pain crossed Jon's forehead. The thought of Betty Middleton as a handful of dust, or worse still, as a grinning skull on a distorted skeleton, was like the sear of a blue ray.

By the end of the second Phobos day—a mere total of fifteen Earth hours—Jon was as good as his word. In the great electro-scanner which Wayne, the elder, had installed, Dore could see the emissary of the council a bare three million miles out. Behind it, in a trailing stream, obedient to the puzzled call of the Martian patrol, came the mightiest battleships of the spaceways. The council, or rather Belor Gramé, was putting forth all its strength to crush the young rebel who had fled from the accustomed mores. Such rebellion, if successful, might prove disastrous. Already, in the short time of Gramé's ascendancy, there were mutterings; both among the

younger scientists and the vast outside masses of the common folk.

But, though Dore cocked an anxious eye at the formidable approaching armament, Jon paid it no heed. He had not slept; he had barely snatched at food since he had landed on Phobos.

JON HAD FINISHED. Everything was in readiness. Mighty machines hummed their song of power.

Jon looked up wearily, yet triumphantly. "I think," he said, "it will work."

Now Dore was exasperated beyond measure. Out of loyalty to his friend he had placed himself outside the pale of the solar system; he had worked harder than he had ever worked in all his life; yet he still didn't quite know what it was all about. And in another Earth day the battle fleet of the council would be upon them! "That's fine!" he retorted sarcastically. "So it works! What happens next?"

Jon grinned apologetically. "Forgive me," he answered. "There wasn't even time for explanations. Now there must be, since, whether you cared or not, you're mixed up in a matter that was none of your concern. Ever since the original John Wayne, my ancestors sensed that the one hope of piercing the veil lay in reproducing, somehow, the conditions which had existed in that ancient nova in Messier 33. Then, and then only, would they discover the means to reverse the conditions and restore the fabulous city to its original state.

"One by one, the long line of scientists added patient bits to the body of their knowledge. My father came upon the final principle. That is, he discovered a method of ripping through the ether of our space time, and unlocking the superdimensional forces of the underlying subspace. In other words, we can repeat what happened eight thousand years ago. We can compress elec-

tron and proton orbits to an unbelievable density; we can direct the subspace bolt through ordinary space at almost infinite speed."

"How about the reversal of the process?" commented Dore. "After all, that is the important phase of the investigation."

Jon's eagerness clouded. "I'm afraid," he admitted, "that is impossible. I've just checked through my father's data. He made a fundamental mistake in his calculations. Not only didn't he discover a reversal method, as he thought, but his own formulæ prove conclusively that it cannot be done."

Dore stared in amazement. "Then what—" he started.

But Jon interrupted. "The problem," he said quietly, "must be attacked from a different angle. Which is, to make a breach in the inclosing space-time wall. Once such a breach is made, the pull of this-universe matter and gravitation will flatten out the lesser warp, tear the veil away. The original condensation of New York was due to the pressure of the force beams from Messier 33. That has been removed.

"Ordinarily, atomic structures are intensely unstable in a condensation state; but the warped space time in which they are unfolded prevents expansion. Release the gravitational restrictions and the electron orbits, the atoms, the molecules, will spring back to their original distances and sizes. New York City and the ravished segment of Earth will once more resume their rightful position in our universe. If nothing else," he ended wryly, "it will prove of tremendous archaeological value; the intact remains of a civilization eight millennia old."

"You still haven't answered my question," said Dore. "How will you make the necessary breach?"

For the first time Jon hesitated. He looked away from his friend. "By directing the *Comet* along a condensation sub-

space beam toward the point where New York once was," he answered.

"But that will leave us helplessly stranded here on Phobos," Dore protested. "It will be only a matter of time for Grame's fleet to penetrate your web curtain of force."

Jon placed his hand on the young man's shoulder. "We won't be on Phobos," he said.

"Where, then—"

"Dore! You and I are going in the *Comet*."

"You're absolutely insane," Dore shouted angrily. "Not in a million years—"

#### IV.

THREE HOURS LATER the laboratory was deserted. Jon and Dore sat, tense and drawn, in the tiny confines of the *Comet*. The silver hull was dim in the semidarkness of the smooth-bore hole that extended deep into the granite interior of Phobos. Dore watched with feverish eyes the slow, inexorable creep of a thin red line toward the zero second on the chronometer.

Jon's lean fingers tightened over the button which was to establish contact with the massed apparatus within the laboratory. At the calculated second, Phobos and Earth would be in such conjunction that the *Comet*, a subspace bullet, would flash across the superdimensional void, and pierce those other compressed dimensions where New York reposed.

Something seemed to choke in Dore's throat. Unwillingly, his glance flung up at the outer port. The long tube of the tunnel focused his vision aloft—but toward the universe of familiar space and time, toward a certain green-tinged planet called Earth. It was bitter irony. That was their destination; yet in what incredible manner would they, if ever, achieve it!

Instinctively, his eye dropped again to the gleaming pointer. It was swing-

ing directly over the indicated mark. "Now!" he grunted.

Simultaneously, Jon pressed his button.

"Well?" queried Dore. Nothing seemed to have happened.

In response, Jon pointed at the ports. A cry burst from his friend's lips. Outside was—nothing. Where there had been the black of inclosing tube, where there had been the heartening sight of a green-tinged planet, was now—featureless blankness, possessing no depth, yet wholly unfathomable, colorless, yet peculiarly gray.

"Where are we?" Dore gasped.

"In subspace—on our way to that other tiny universe."

"How long will it take us to get there?"

"In Earth time, a matter of days, I think. In the time of this superdimension, there is no way of telling."

Dore sat numbed, trying to figure it out. There had been no jar, no roar of departure. Yet why should there be? They had slipped immediately into subspace, where all things were different. A thought came to him—made him feel strangely queer. Already they must be shrinking to dimensions that were infinitesimally small.

Then another thought slashed like a lightning bolt through his brain, brought him jerking to his feet with a hoarse cry.

"What's the matter?" Jon demanded.

"We forgot the one elemental fact that spells disaster," Dore groaned.

"Which is——"

"That New York, toward which we think we're heading, was inclosed in its own gravitational space time about eight thousand years ago. Its orbit is therefore no longer ours. During that time the solar system, the Milky Way, the expanding universe of which we are a part, have shifted their positions by uncounted trillions of miles. Heaven

knows in what part of the hyper-universe New York is now."

A deathly silence followed his outburst. Jon was white with realization. They were speeding through subspace toward a nonexistent entity. They were cast adrift in a featureless void!

But even as grim despair corroded his heart, there was a blinding flash within the slender hull of the *Comet*, a screaming and roaring of thunderous sound. Jon flung to the nearest port, caught incredible glimpses through the crackling blaze. Glimpses of an atmosphere, green-tinged—of tall structures, strange in shape and fashion, rushing up to meet them—of water, placid and smooth, beneath.

He barely had time to cry out, "You were wrong, Dore! Some connection must have inhered through the ultra-dimensional electron wave trains. We've reached the ancient city of New York!"

Then there was a crash, a splintering of metals, a grinding of consciousness into dust——

JON WAYN was certain that it was all a dream.

"Of course!" he told himself joyfully, and yet with a touch of queer regret. "That explains everything. I fell asleep after deciphering that nonsense, and the story induced this nightmare. Perhaps it was also something I ate. I never defied Belor Grame; I never went to Phobos; and certainly the *Comet* never crashed into this incredible business. It is true Dore Allyn is over there, weaving crazily to his feet, with a gash on his forehead. It is true that the *Comet* lies over yonder, half submerged in blackish water, a hopeless wreck, but they are both part and parcel of the dream."

Yet the remarkable vision persisted. More, it took on an extravagant aura of which even dreams are chary. For this city of New York, on whose outskirts he seemed to be, was no city of

long decay and dreadful desolation. It was alive, bustling, and there were thousands of strange human beings, clad in outlandish costumes, with heads unaccountably thick with hair, who were pushing and moving around him.

But if this had been all, incredible as it seemed, there might have been a possible explanation. Perhaps the people of this immured town had found the means to manufacture fresh air and synthetic food from their limited surroundings, had lived and bred through long, weary generations until the very memory of another and vaster universe had disappeared.

Yet how account for the girl who was cradling his bloody head in her lap? She was the very image, the very representation of that ancient, faded picture which had stirred his heart to unaccountable emotions. Betty Middleton! Impossible, of course. She was either the delirium of his dream or his wounds; even, perhaps, strange as it might be, a descendant of that long-dead girl.

Yet how account for the fantastic words which tumbled from her quivering lips, words that were archaic in texture, yet melodious and understandable? "John! John! my darling! I knew you would find a way to rescue me, to rescue us all!" Her voice rose in shining pride to the pushing, eager thousands who ringed them in. "We are saved," she cried. "This is John Wayne, the man I love, astronomer of the Kelton Observatory. He knows the way back from this incredible world into which we were catapulted."

"How about those crazy clothes of his?" some one in the crowd called out sharply. "How about that queer-looking plane in which he crashed? How about that other fellow, bald as a coot and twice as funny?"

The girl looked down quickly at Jon. A momentary puzzlement sprang into her eyes; then they cleared. "Silly!"

She laughed. "Of course he's John Wayne. I'd know him anywhere. Those clothes——"

Jon Wayn jerked his head out of that too-comfortable lap, rose unsteadily to his feet. "Let us understand each other," he said in harsh, strained accents that were clipped, staccato, compared to the speech of these others. "I am Jon Wayn, true enough. But you—what is your name?"

The girl looked surprised, indignant. "Why, John, is this a jest? Have you already forgotten Betty Middleton?"

He staggered at that, clutched at another straw. "You mean," he said with desperate eagerness, "that your great-great ancestor's name was Betty Middleton?"

"I am not telling of the names of my ancestors," she said coldly. "The crash must have addled your brain, John Wayne."

He clutched at his forehead. In truth he must be mad. "How long," he still insisted, "has this city of New York been cut off from Earth?"

The girl looked at him with a troubled expression. The strange concourse of stranger people muttered, tapped their heads with significant gesture. "You ought to know," she said very low. "I left you at Kelton on the evening of May 11th. The transcontinental flier brought me to New York the morning of the 12th. At about two in the afternoon this—this happened. The city has been in a panic, frantic with fear ever since. Only I felt confident"—her voice broke pathetically—"that you would extricate us somehow from this awful predicament. You came—to-day is the 13th—but—but——"

The ground was spinning around him. "What—year—is this?" he managed with difficulty.

"Year?" she echoed. "My poor boy—the shock has been too much. You need rest, quiet. A slight touch of



amnesia, perhaps. Every one knows this is the year 1945."

DORE was at his side. "Steady!" he warned. "We've got to think our way out of this." He motioned Betty away with imperious gesture. She obeyed, watched them from a distance with puckered frown. "That—uh—young lady is obviously the one of the picture. And just as obviously, while almost eight thousand years rolled by in our time, only a day has elapsed in here."

"Obviously," groaned Jon. "I should have figured that out. Time is purely relative, a matter of electron speeds. Since they are here under tremendous compression, their orbits have slowed to what in our space would be almost immobility. Hence time slackened, too. A day here is a matter of millennia outside. But how can I explain to her—to all these others—that they are anachronisms, living long past their allotted period? How explain to this girl—this Betty Middleton—that I am not John Wayne, her lover, but his child, hundreds of generations removed?"

Dore Allyn stared swiftly up at the circumscribed sky. "Don't try to!" he whispered surprisingly. "Something tells me we managed to burst into this tiny inclosure which holds ancient New York, but that the gravitational puncture healed, so to speak, before the space-time pull of our own universe came into play. We're marooned here, along with these primitive folk, our remote ancestors; and we'll have to manage.

"It is enough for us to know the dreadful truth; if we should disclose it to their limited minds, they might go altogether mad. And it happens that we possess sufficient scientific knowledge to make this strange little world entirely habitable, both for this generation and for all those that may follow. Who knows"—and Dore made a wry grimace—"perhaps even some day we'll find a method of escape. Or, if not us, at

least our children's children. The tables of your ancestor, John Wayne, are reversed with a vengeance."

"But the girl—Betty Middleton," Jon protested thickly. "She—she thinks I'm my own ancestor. How can I disabuse her of that, without giving the whole story away?"

Dore grinned. "Obviously you look just like your remote ancestor. I always thought you something of a throwback—with that cluster of hair on your head, your straight nose and nonbulging forehead. Take advantage of it. *Be* John Wayne, man of the twentieth century!"

Jon drew back appalled. "It wouldn't be fair."

"Don't be a fool," his friend snapped. The crowd was getting impatient, surging toward them. "You love her. I saw that when you stared at her picture. It's a queer business, but that's your concern. Go to her; tell her you feel better now, that the past is still a bit hazy. She gave you the clue; amnesia's the word."

Jon glanced undecidedly toward the girl. His heart raced. She was beautiful—far more beautiful than the time-worn likeness. And there was that in her eyes which made him feel all queer within. Yet he still wavered. "How about you, Dore?"

The young man, bald—as that coarse primitive in the crowd had remarked—as a coot, product of the ninety-ninth century, grimaced. "I'll manage somehow," he said. "I may even, in time, simulate your atavistic emotion of love for some hirsute, sloping-browed young lady in yonder group of semisavages."

In spite of himself, Jon grinned. Then he looked at Betty Middleton again. Anxiety, grief, something far stronger than either, shone nakedly in the candid depths of her eyes. His own soul rushed out in response; his arms flung wide.

"Betty, my dear—my dear!" he cried. He was committing himself irrevocably—and was wildly happy because of it.

# THE INDESINENT

*Wisdom—which would rob man's  
life—of exciting uncertainty!*

by D. D. Sharp

**D**R. 'ARTHRO STYKAL' was closely watching a rat and a snake in a glass cage set against a table of the laboratory. Because of the aggressive glide of the reptile, Stykal's mind pondered a question which had puzzled more than one scientific observer.

What caused individuality? Why was one animal of the same species vicious and another cowardly? Why was one man cruel and another kind-hearted? Was personality influenced by heredity and environment, or physical structure of the brain?

He was testing that last thesis now. He had grafted the brain of the rat into the skull of the snake, and the brain of the snake was now governing the actions of the rat.

He had expected a marked disruption in the habits of both animals, but the rat continued to act as a rat. It scurried when a cat was placed near the cage. It ate cheese and cowered before the snake that had its brain. The snake preyed upon mice, rattled its ire, struck aggressively when a stick was poked into its den, *and now, was swallowing the rat which had its brain!*

Brain matter, then, could be only battery power for thought and no more controlled thought character than a dry cell which powers a battery radio receiver controls the program it magnifies!

Since Stykal had continually observed that children of the same parents, brought up in the same environment, sometimes had contrasting personalities,

that explanation was already ruled out. Now that individuality seemed superior to brain matter, the master of every organ of the body which supported it, Stykal concluded that personality must be a wave meter of life, which is itself but an electrical manifestation of a cosmic integer.

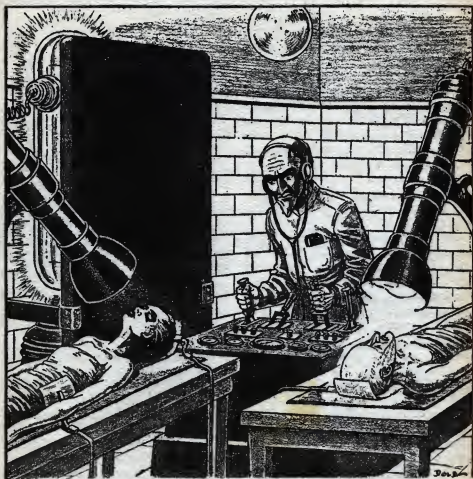
Stykal was the secretive type of genius who works and tells no man his ambitions or his progress until the completed formulæ is ready for demonstration. Upon this new conception of life as electrical waves metered to each personality, he spent many subsequent years.

From his energies and his genius many new laws of life and conduct had been reduced to mathematical formulæ. The first startling announcement he had ever made concerned the deplorable ignorance which allowed an element of chance in the ordinary affairs of life. Natural law was constant, he declared, whether it was the inverse ratio of mass to distance which balanced the orbits of the mighty suns over his head; or the valency of atomic structure quite too minute to be seen with the aid of his most powerful microscopes. The one element he abhorred and desired to conquer was uncertainty, whether it be astrophysical law, or a sudden attack of holdup men.

After some years of further experiments for knowledge of thought-wave meters, he decided that he had advanced far enough to apply his experiments to human beings.

In his charity wards were two cases,

# STYKAL



*The two upon the tables stiffened. Curses smothered in the old man's throat. Higher and higher stepped the pitch of the generator—*

both hopelessly incurable. No. 1 was a man of near forty; No. 2 was a girl, probably twenty-three or twenty-four. Neither had more than a few weeks to live, and both were constantly administered opiates to deaden unbearable pains.

Stykal submitted to each his proposition, not a hope for cure, but an offer to science and the search for truth. The girl acquiesced at once, bestowing upon an aunt the sum of money Stykal offered.

The man rebelled, but the size of the sum bought his acquiescence. He demanded it in gold, counted into his skinny hands. He was prematurely old, emaciated, evil of eye, bitter of tongue, resentful of the certitude of early death.

The girl, though equally sick and condemned, had a personality as nearly opposite as human nature goes. She was a patient little thing, uncomplaining, serene. Her large, sunken eyes followed

Stykal about the room. "I am more than willing to give my bit for the advancement of human knowledge, doctor, even if I can never hope to get well." She smiled again, and though her voice was no more than a breathless whisper, it carried an admirable and inspiring valor.

Stykal could not endure her countenance and avoided her eyes, accustomed as he was to dominating face-to-face encounters. He left the ward, went up to his laboratory and waited for his subjects with his mind once more abstracted by the idea of widening man's narrow horizon of known laws, with as much advance as his energies could make during the brief period of life expectancy that was still left to him.

The door opened and the girl was wheeled in by a nurse at the foot of her bed. Behind her was the cursing old man. He glared at the Roentgen lamps, the hard, flat surface of the mahogany tables under them. He raised himself to an elbow, ground his teeth together and then snarled viciously, "Go easy with me old sawbones or I'll catch up with your damned soul in hell!"

He railed at the weight of the blankets which covered his shriveled form, at the jostling of rubber wheels which glided with oiled smoothness, and then at the glare of the lamps when Stykal put them on.

The two nurses transferred their patients to the hard, dark boards, asked if that were all, and wheeled their cots back into the hall. Stykal closed and locked the door, then he laid an electrode against the girl's side and one at her head, plugged into a socket, adjusted head phones upon his ears, moved a lever cautiously, then removed the head phones to ask if she could feel the warmth of the current. She could, so he repeated the routine with the man, but the old rascal would not stay put, and Stykal used a clamp to hold the electrodes in place.

Head phones upon his ears again, Stykal swung a switch. A stiletto of electric fire crackled its vivid tongue against a silver ball high above the lamps; a glow, red as iron fresh from the forge, waxed along a heavy copper plate that was sealed within a giant vacuum tube beyond a bakelite panel.

Stykal closed still another switch, and into the stillness of the room flowed the rising whine of a distant generator. The two upon the tables stiffened. Curses smothered in the old man's throat. Higher and higher stepped the pitch of the spinning generator. Stykal stood clutching the lever of brass, his head cocked to one side as though he were listening. Across the white tiling of the floor the silhouette of his profile was sharply pointed, but his eyes were moody, the eyes of a man who dreams and dares.

An alarm clock rang. Stykal pushed back the lever, lifted the switches. The man lay still. The girl squirmed and tore away the electrodes with feeble fury.

Stykal was calm as a surgeon at an operating table, as he mastered the stifling eagerness which pounded in his heart. The girl was railing breathlessly. He leaned forward to catch the smothered whispers. The words were unsubmitive, no longer gentle and refined, "Mayhem! Mayhem!" she screeched. "Sawbones or devil, I'll even with you in hell!"

Curses from the once-gentle lips grated upon the joy in Stykal's heart. Except for the inflamed hate in the girl's eyes she seemed the same pallid creature who had so shortly before submitted to the induction of his machine. But he knew, even without the proof of the curse, that the girl, not the vile old man, was dead. The current which had forced this opposite individuality upon her body had also driven out the electrical impulse which carried the wave length of her gentle soul!

The horror of the transposition yielded the satisfaction of complete triumph over another unknown law, and still he could not endure the desecration of hate and curse upon a body so wholly consecrated to gentleness and sacrifice. Impulsively, he felt along the bench beside him, to choose a dark, squat bottle, and then a hypodermic syringe, which he tested by drawing a crystalline fluid into its barrel and squirting a little into a near-by sink.

Above the squirming form of the girl he halted, then impetuously grasped a fold of pale-white skin along the emaciated forearm, plunged the needle deep to raise a long, white furrow above its steel, then pressed down the plunger to empty the barrel.

He waited a moment for the blood stream to drink up the fluid, then pulled the needle from her flesh, cleaned the syringe, replaced it in its box.

Rebellion died from the hazel eyes and the pale head relaxed to its pillow.

Stykal brooded. Here was the proof of a staggering and inspiring causation, connecting the idea of man to the idea of the everlasting infinite by natural and tangible law. From it a thousand paths led out to startling disclosures, and he, limited by physical handicaps, could now choose but one of them to follow through. Which it should be was a matter that must be pondered and chosen with care. Now, he must close out the menace of those two bodies under his lamps.

He pressed a buzzer.

Dr. Osteroff, an associate, pushed open the door. He was tall, middle-aged and poised. He had fine, well-formed hands, hands that were as skillful as they appeared.

Stykal nodded grimly toward the still forms under the lamps. "Both," he said in a low tone. "It was useless."

Osteroff bent over the girl, pushed aside the sheet that covered her, then pressed an ear to the tight skin upon

her ribs. He rose gravely, moved to the grizzly ruffian and looked down. Then he placed a hand upon Stykal's shoulder. "No one always succeeds, my friend, not even the great Stykal. Trial and error are still the implements of success. Uncertainty is still the enemy of us all." Osteroff did not guess that Stykal had experimented with any other idea than accomplishing a cure.

Uncertainty? The very word antagonized Stykal. It emphasized the narrow horizon of human achievement and the failure of scientific calculation to cope with the trends of natural law. The curse of it obsessed him until he felt that his life itself would be useless until he conquered that Nemesis which punished every endeavor, and beset every human scheme.

He crept to the window and straightened the back which had bent so long to the arc of stool and bench. He clutched at the casement and leaned his wrinkled forehead against the glass. His hands were clammy as they pressed his throbbing temples. He looked at them. How withered they were—the hands of an old man. While he had been engrossed in his work old age had slipped up on him.

He looked at his face in the glass; dark, burning eyes stared back, but the pointed beard was almost white, and the brown skin of his face ran far back over the scalp of his head. Uncertainty? Quite suddenly, as though he had awakened from a dream, he understood that old age would defeat his attack upon it. He turned upon Osteroff and shielded his aching eyes from the glare of the floodlights against the plastered walls.

"Osteroff," he said, "I am on the track of it. The scent is warm and I am getting old. I need new blood—strong new blood."

Osteroff pursed his lips. "You may be right," he agreed after a moment. "A transfusion might be just the thing."

Stykal laughed hollowly and blinked



through the great window. Below it the world moved in endless tumult, swarming from the ends of the earth through the streets below his laboratory walls. There pulsed the blood of ambitious youth, warm new blood stirring young minds with zest for battle, for whatever opportunities the years might bring, not yet mindful of its certain end. There rash expectancy hooted at inevitable defeat. The young, now and forever, eager to try where even Stykal would fail! Youth in endless, immortal tides, and to each a glass of it, before the sea ebbed out beyond the farthest reach.

He shrugged, but did not acquiesce. Once young, soon old, then infinite decay, was the accepted law of life, but Stykal had reversed other laws men had tagged immutable. Old as he was, short as was the strip of slowly moving tape upon which he still might write, he wondered if one last sentence might not change the thesis of the whole.

"You misunderstood," he said softly, till looking down into the street. "There is a scripture which dictates that new wine is not put into old vessels. I wish a successor, a sound-bodied young fellow with brains, whom I shall make an apprentice, and my heir, to complete the works I have started."

"I still prescribe the transfusion. The heir can be easily found."

"He must be sound, perfectly sound," Stykal barked. "My work is too complex to risk to any other."

"He will be sound as God makes them," Osteroff agreed.

Several weeks later the whirl of a buzzer caused Stykal to glance cautiously around his laboratory. There were no evidences of his work uncovered which might arouse alarm.

He crept from the high stool on which he had been perched, unlocked the door, pushed it back, and with appraising eyes regarded the powerful young man who

looked expectantly past him as though seeking some one else within.

"You wish to see me?" Stykal demanded.

"Dr. Stykal?" the youth queried, as though finding it difficult to associate such a shriveled old figure with that all-powerful name.

Stykal nodded.

"Dr. Osteroff suggested you might give me an apprenticeship. I am Mantis Douglas."

"Come in," Stykal invited, his heart thumping in a manner to give him alarm.

The boy hesitated.

"Said the spider to the fly," thought Stykal. "The fellow's already suspicious. I must say something to put him at ease." Then aloud, "I am an old man; perhaps a bit apprehensive." He smiled charily, "I am merely anxious that I shall make no mistake. My work must go on. Uncertainty must be eliminated from every law of life, even the uncertainty of choosing a successor."

"My learning is nothing to brag about," the boy stammered. "I—I don't want to deceive you, but I'm crazy about science. I hope you give me a chance at the job." His eyes strayed to the rows of tables, to linger upon magnificent microscopes, slide cabinets and racks of test tubes, as though eager to take hold of them.

"I'll try you out," Stykal agreed, scarcely concealing his own eagerness as he coveted the supple strength of the muscular arms, the glowing health in the flesh and eyes, and the years of future work that was promised them.

Months before Stykal could train Douglas to the point he had planned he became terrified that, after all, some overruling omnipotence might snatch away the success of his idea, for he found himself suffering from more and more violent heart attacks. He recalled with

distress that Fate had always overruled the strength of man, that every legend of eternal youth carried a slip at the very lips that planned to drink of it. What purpose had that grim intelligence which so inexorably shortened the measure of a man below the century of life? Of what design was that far-extending shadow from under which no human strength might hope to crawl?

He hurried his plans to cheat the inevitable and arranged a double control in his X-ray room, with which he could ostensibly instruct Douglas in operation of the machine, but at the same time kick in a switch which would short cut the decoy X ray to circuit a current from his body to that of the boy's, which would drive his own wave length into the young man's body.

Down in his charity ward was one John Danks, who was taking X-ray treatments. Danks would be the decoy, an excellent witness that the death of Stykal was accidental, and in no way contrived by young Douglas.

Stykal surveyed the boy's firm, capable hands. "You have firm nerves," he said. "You could handle dangerous currents if you knew all that I have learned."

The boy nodded with solemn eyes.

"In a few moments I am to have a patient. We will put a screen of lead foil over the healthy skin of his face, then expose the malignant tissue to the benign powers of alpha and beta rays from which have been screened the harmful gamma rays. The lamp will be closely adjusted for strong penetration. There must not be one minute exposure, more or less, than the chart indicates. The alarm clock will signal when the current is to be cut off, but one must watch closely to keep the current at constant flow. You have steady nerves; you could do that."

White-clad nurses wheeled a thin man into the room. He was placed upon a

mahogany table, below a strange lamp with queer filament and metallic screens. When the patient was quiet, Stykal drew down the lamp and adjusted it close to the man's head, measuring carefully the distance from lamp to the face.

"We are giving you five minutes, ninety thousand volts," he advised Danks methodically.

Danks stared fixedly at the glass walls of the control room. Stykal motioned Douglas to follow him into the glazed booth. When Douglas closed the door, he explained the controls again, and went to the dual levers on a bench not two feet away. He pushed a lever and generators hummed to dim the office lights.

"Watch him closely," Stykal cautioned as the incandescence of the X-ray lamp illuminated Danks' pallid face. "The leaded glass protects you from any harmful effect of the rays. Now, grasp the controls. I will correct with this lever."

Douglas nodded and took the brass lever in one hand. The metal of the stool upon which he sat would complete the wave-meter circuit. Stykal's withered hand clenched the electrode which would put the charge into his old body, that would ride down Douglas' younger wave length and thrust Stykal's more ingenious and wiser wave length upon the young corporality.

There was a stifling constriction in his throat; his heart pumped alarmingly. Stykal clutched the brass and prayed for control. "This once, O wise and mighty infinite!" he begged. "This once, for the advancement of truth and the defeat of chance."

For one sober moment his eyes rested upon Danks' tense face, immobile under the sputtering lamp. Danks was watching him, lips tight, jaws set. In his eyes was suppressed desire and rebellious resignation, through which peered forbidden hope. With all that racking pain, the man had a tenacious desire to live.

Stykal was caught in a sudden disgust for everything toward which he had worked. What ungodly spirit possessed the man to battle so desperately for another month, another day, another week, in which to live? A day, a week, a month would yield him nothing more than had the ones just past! What was the lure, the intangible deceit which always promised and never fulfilled?

For the moment he was almost persuaded by the very futility of enduring purpose in human affairs. After all, why shouldn't his soul rest with his bones and the two of them lay down their work together?

Then the old dominance that had mastered him so long, the indefeatable impulse which had beaten down obstacles and pain and fatigue, to fight unyieldingly, even when the fight offered no other reward than supremacy of spirit over obstacle, came charging in from cosmic vibrations. He grasped the brass tighter and kicked down the switch under his feet.

A cataract of blood-red fire poured over his eyes. Thunder rolled in his ears, and an acrid, brassy taste spread from his mouth down into his throat. Washed in burning fire, he tottered.

One second, as through a bloody mist, he saw that Danks had risen upright on his table and fires were bursting from the contact of his head with the ninety-thousand voltage passing through the lamp. Then the bloody fire over him curtained Danks and the room, and his withered body slumped with dangling hands until is sprawled across the bench, unconscious.

Despite the low amperage of the thought-wave transposer, Stykal felt death gripping him. He seemed to be evaporating into a magnetic field which hovered around the body but moved further and further away, much like the flame of a candle that is burning in weaker and weaker oxygen. It was an

alarming sensation. Red, vitriolic fire walled him about, carrying him slowly and resistlessly ahead of the bombardment toward the body of the boy who still grasped the controls in a rigid grip, though his head lolled against the partition glass. Then, in a wink, the resistance of the boy's will was broken, and Stykal's terrified soul possessed the coveted body.

He swooned, as a freezing man might fall, upon opening a door that is a haven from the storm.

When he became conscious again he opened his eyes amazed. Alive! He was alive!

For several minutes he sat dazed, his head propped against the glass, his legs twisted around the legs of the stool. Strong, sturdy legs they were, strong and young. The fingers he pressed upon his cheeks were also strong and firm—soft cheeks they felt, plump, unwrinkled cheeks without those old distressing hollows along his jaws. He was young. Young! Young!

He repeated it aloud to himself, and then repeated several involved mathematical equations. Yes, he had his own ingenious mind, his aptitude for mathematics. His soul was the soul of Stykal, but his flesh was the flesh of a boy. How amazingly equipped he was for battle against obstinate physical laws! Experience and youth dominated by the talent and will of Stykal!

Beyond the glass Danks lay motionless upon the X-ray table. His stillness and posture was that of death. His face was horribly distorted and there was a livid sear where the live wire had burned his forehead.

Stykal had no emotion to waste upon the dead man. He was a man out of time, with no temper for any form of weakness. Even in his dazed, unadjusted state he felt that his crime could be justified only by the work that was to be performed. Douglas might well be

paid only if his strength carried genius to the goal of its desire. Chance, and guess, and every form of uncertainty must be made to yield its equation to human endeavor.

He glanced sidewise at his own discarded body; a miserable and distressing sight, a clammy, marasmic prison, that had fettered the brilliance of his genius with its decadence. There was a promising thrill in this rejuvenation that warmed his limbs and quickened his pulse. It renewed within him expectant anticipation, a confidence for the battle ahead, a love of life long forgotten, long forsaken.

His strong young legs wanted to leap and dance, quite unaware that they bore the wisdom of ninety years. His feet were light, but his heart was grim. His was the soul of purpose. Before he was old again the whole world would have a clearer horizon.

The hall door opened. A nurse in novice blue stepped into the room, stared past him at the old body fallen into such queer distortion. One moment she stood quite still, with her small, clenched fist pressed to her wide-open mouth, then, with a terrified shriek, she fled, leaving him alone.

With the experience of ninety sagacious years Stykal had no trouble in avoiding suspicion of guilt. For many months he worked only behind the safety of locked laboratory doors, lest there be curiosity as to his new ability, though he knew very well that such an event as had been enacted was too far in advance of the knowledge of his generation to be remotely suspected, or even admitted as evidence in any court of law. Still, he wanted no comment. Genius works best when unwatched, and the weight of his problem was massive.

As he worked, months passed swiftly into years, and he uncovered factor upon factor. Yet as he advanced toward his objective he found less and less desire

to utilize the substance of his knowledge. Where there had once been pity for men buffeted by unknown law, he began to wonder if there was not more merit in such a scheme than he had first suspected.

His great god Wisdom helped no better with the new difficulty than a wooden *santo* upon a peon shrine. Not nearly so much.

By that time he had equation for every coming event; equations which resolved the future into known quantity through mathematical law. Known to him was the outcome of every chance. He knew what each to-morrow would surely bring, how to beat its adversities, avoid its dangers, where to capture its best gifts. He knew just what each man would say, how he would act, and the way to persuade any one to his own opinion. He knew just when it was time to bring out the old wave-meter machine to avoid sickness or death, and which youth would make the most perfect and healthy house for him to steal.

Newborn babies grew up, wrinkled, and slipped into a narrowing parallax of the past. He moved among new generations, and still newer ones—his secret quite unsuspected—bored with a great disgust for the endless repetition of sameness in every new-hatched brood of optimism; their eagerness to remake the old world, their broad pride in trite knowledge, newly acquired.

Cynically he watched them come and go—new lives, new hopes, and the same old hopeless plot; but like the wise old mother of them all, endured it with no rebuke.

Only when he was all alone would he sometimes quietly thump himself upon the chest and boast sardonically: "What a hero am I, to know and hold my tongue. Here lies wisdom indeed, holding in my soul that which, if spoken openly, would rob man's life of its exciting *uncertainty!*"

# DURNA RANGUE

by NEIL R. JONES

BERN GREGORY lay near death in the Venusian city of Deliphon. He wondered where Jerry was. Jerry was all he had left to link him to a glorious past of wealth, prominence and happiness on the mother world. The first great blow had fallen when he was scarcely seventeen. His father and mother had been on the giant space liner, *Indigo*, struck by a meteor nine million miles off Mars. Every one remembered that date, June 12, 2342. It had seen the major space disaster of all time. And now the third and last great blow stared him in the face: he was dying.

Jerry had stuck by him in his poverty and hardships. When the loss of the family fortune had left him penniless, he and Jerry, his faithful servant, had left South America and departed across space to the colonies of Venus. Jerry was ten years his senior.

They had drifted from one colony to another, living virtually from hand to mouth. Their latest occupation had found them gathering margra root in the steaming, misty swamps, defending themselves, with electric pistols, against ugly monsters and unfriendly troglodytes.

But the greatest and most deadly enemy of the swamps had slunk by their defense and had waylaid Bern: swamp fever. The malady had taken hold of his brain. Nothing could save him now. With what little money they had saved, Jerry had gone and brought the best brain specialist in Deliphon to their squalid quarters. The doctor had made a valiant effort to save the young man, performing a minor brain operation

which had stayed his end for several days, but now he was sinking again.

Why was Jerry gone so long this time? There had been a queer, troubled expression on the man's face when he had left. Bern had interpreted it as sorrow. He could last but a day or two longer.

Hallucinations had come to travel in phantasmagoric procession through his affected brain. They were returning, he vaguely realized. He saw faces of people he had known in that gay, happy past many years ago on the planet Earth. It all seemed like another life on another world during a previous incarnation. Bern emerged from his coma sufficiently to wonder about Jerry again, as more dreams came to haunt him and soften, to his glazing eyes, the harsh details of the dark, dingy room. Hushed voices spoke soothingly to him. He heard his mother's voice. Then it was Jerry who spoke softly to him, his voice rising suddenly in tremulous alarm as Bern heard, yet gave no response.

"Master! Master! You—you're not — Oh! Oh, Lord, no! I—"

Bern roused himself and turned his head weakly at a shimmering column of dark shape which bent above him. He felt a cool hand on his forehead, a hand that trembled as with palsy. His eyes came to a focus on Jerry.

"I—I'm all right. Just resting, Jerry — old boy."

Jerry muttered a prayer of thanks. Bern became suddenly aware of a third person in the room, a tall shadow keeping discreetly in the background.

Bern's voice raised itself wonderingly. "Who is there?"



# NEOPHYTE



*"Jerry, what have they done to you? Do you hear me?"*

"Bern—it—it's your last chance of life!" stammered Jerry, misery and supplication in his eyes. "You've got to take it! You've just got to! I can't see you go, lad!"

The faithful serving man sobbed the last words and let his head sag despondently. He seemed momentarily at a loss to offer any explanations, and Bern turned questioning eyes on the man who

stood by the door. He felt his own gaze locked and held by the eyes of this mysterious individual, and a strange thrill of energy vibrated surprisingly through his weak, wasted frame. The stranger stepped slowly forward to the side of the bed where he loomed above Jerry, never removing his smoldering eyes from those of Bern.

"I am an Asurian."

THE TONES of his voice struck sibilantly on Bern's ears. The few words were all significant. He was an emissary of the cult, the Durna Rangué, an organization purported to deal in condemned sciences. Stories of their work symbolized horror and death. They had been banished from the Earth for their reputedly abominable practices. They had fled to Mars and located in the gray cliffs at the edge of the red Silmóno Desert, far from the nearest colonies. This man was a proselyte of the cult, or what was more likely, Bern thought, one of the priests.

His presence represented no puzzle. The Asurians were masters of super-surgery of the brain and were even credited with brain transposition from one body to another. They were wizards in all types of surgery. Their coolness and cruelty in vivisection of the living, as well as the dead, had been principally responsible for their banishment from Earth. They were past masters of hypnotism, and among others of their secrets was that of age and immortality.

It was said of them that they could either accelerate age or suspend it, whichever they wished. Since they had fled to catacombs in the gray Martian cliffs, they had created weird and fearful monsters of human shape, so rumor had it. That they had performed minor brain operations upon the Martian ter-seg birds, giving them a limited intelligence and speech, was an accepted fact.

The Durna Rangué offered a hypnotic lure to the dispirited, the beaten

and sensuous weaklings and to those viewing life as only a bitter illusion. It was whispered that for the use of their bodies, neophytes of the cult might spend a good share of their lives in deathless sleep, realizing the happiness of their uttermost desires by the scientific induction of synthetic sense through the thought channels of the imagination.

The idea of enlisting their aid in saving his life was not a new one. Jerry had suggested it, only to find his young master strongly set against the idea, even though his life hung in the balance. The thought had made his flesh creep. He was cool now, however, and he looked squarely back into the fascinating depths of the Asurian's eyes, calm and unafraid.

"Whatever you have come for, I can make no bargain with you."

"Better a bargain with death, then?" the proselyte barely whispered. "You are very far gone, but you can yet be saved."

"For what?" pursued Bern listlessly. "To become a monster—or an assortment of physiological parts to stock your laboratories?"

"You have heard wild tales of rumor," the Asurian's voice purred assurance. "It is true that we are cold, calculating scientists, but what we do is for the eventual betterment of civilization."

"I want none of Durna Rangué's betterment," affirmed Bern quietly. "Leave me die in peace."

"Our price is but a modest one," the proselyte urged. "Hear me out."

Half-heartedly, and lacking the strength of further objection, the young man looked up and considered his visitor searchingly. Somewhere he had heard that the Durna Rangué were not given to falsehood, that their word might be relied upon.

"What is your price?"

"You must become one of us and spend the rest of your days with us. At

some time or other, if you serve us well, you may be rewarded with a synthetic lifetime."

"The dream life. Yes, I've heard of it," mused Bern dubiously. "And then I would be vivisected or fashioned into a monster."

The Asurian raised deprecating hands. "No harm will come to you. Your case is an interesting one. We shall feel triumphant and well paid if our skill recalls you from the brink of eternity over which you are dangerously hovering."

ALL THE GLOOM and horror with which life regards death was brought into play by the Asurian's subtle suggestion. Self-preservation battled his cause for him. Bern was interested, yet remained wary. Jerry was still on his knees beside the bed, strangely silent, his head bowed gently upon the counterpane.

"If success is to be your reward, why must I remain with you after I am well again? Why cannot I return?"

"Because no one who enters the sanctuary of the Durna Rangué can ever return."

Bern felt himself mystified and intrigued. He had little to gamble. Death lay on one hand as certain as the coming of night. Life beckoned, even life with the unwholesomely regarded cult. If the gloom and forbidding mystery of the Durna Rangué caused the scales of decision to balance evenly, it was his remaining spark of adventure and indomitable courage which eventually caused it to tip in favor of the cult.

"I will go with you," Bern stated, "providing you promise. I shall not be vivisected or changed in any respect from my normal self."

"Aside from the operation on your brain, you may rest secure in the knowledge that no organ of your body will be removed or changed, no drop of your blood spilled—nay, no cell of your body

disturbed from its position. But you must remain with us always as a helper, you realize."

"Yes, I realize it."

The bargain was made. He looked at the Asurian inquiringly.

The latter spoke. "You must be taken to Mars."

"I can never live that long."

Bern sighed in sudden alarm now that life, even gloomy and futile as was its nature, had been held forth to him once more.

"You will go there in a suspended state. There is a space ship not far from here which will take us. It has been waiting."

The ominous surety of the Asurian's prearranged plans suddenly unnerved him. A subtle hint of veiled triumph struck a note in the proselyte's voice, as if all was not as it had seemed. Bern felt his eyes locked with those of the Asurian, and again he felt that unworldly transmission of vibrant energy thrill his wasted body. The eyes glowed and smoldered as if concealing veiled fires. Bern felt them drawing him closer. He wanted to say good-by to Jerry.

"Jerry!"

With a mighty effort he wrested his gaze from that of the Asurian.

"Jerry!"

"Yes, master."

The words were spoken with a desolation of hopelessness that did not escape Bern's attention. The servant raised his face, and Bern's clearing vision picked out an appalling expression of mute terror, dry and lusterless eyes reflecting the misery of a lost soul. Bern's heart sickened, yet he steeled himself for the parting.

"Jerry," Bern whispered comfortingly to his faithful servitor. "I am going now. We'll never see each other again."

Jerry stared at him in speechless misery. Bern wondered at the dryness of his servant's eyes. Strangely enough,

this did not seem like a symbol of parting. He knew his lifelong companion too well. The Asurian spoke, as if in reply to the dim, haunting queries in Bern's troubled mind. Once more his eyes held those of the young man. This time they were irresistible. They were clear and burning, swelling to fill his vision like a pair of awful, approaching furnaces.

"You are not leaving Jerry. He is coming, too. It is part of the bargain he made with me."

Jerry's hitherto meaningless terror was explained with the meteoric speed of thought, as Bern's consciousness dimmed and faded away.

HE KNEW NOTHING of the trip across space nor the weeks of patient vigil which Jerry spent beside the quiet, rigid body of his master. Mars loomed into sight. They came down upon the gray cliffs near the edge of the Silmono Desert.

Several floating, shadowy forms circled the near-by valley on flapping wings. They were terseg birds of the cult and were flying above the heads of two people on a steep rise across the valley. Jerry recognized one of them as a woman. They were probably mazi-nite miners, man and wife. A cottage nestled in the background. How dared they live beside such terrible neighbors?

The last thing on which Jerry set eyes before the ship sank into a dark pit was the Sun sinking over the world's edge. His hopes sank with it, and the gloom of the dark shaft invaded his soul.

Bern came to his senses amid strange surroundings. Whispering figures bent over him where he lay, their heads sunk deep inside gray cowl. He turned his head. Small figures, men who were dwarfs, stared at him stupidly. A skeleton stood in the corner without any visible means of support. Bright lights shone on him from behind. Shelves extended around the room from the floor

to the ceiling. He wondered and was bewildered at the array of apparatus and implements he saw all about him. Jars of varicolored liquids lay on the shelves, and his wide-distended and darting eyes recognized articles of human anatomy floating in them.

Memory flashed back upon him, and instinctively he knew where he was. They were going to operate on his brain. His eye caught a subtle movement over in the corner, and he sat bolt upright as he saw the skeleton walk to a doorway and disappear, long, bony arms swinging leisurely.

He had little time to ponder the fact before it suddenly came to his attention that he had risen to a sitting position with surprising ease. Where was his former weakness, which had made such an act impossible? More hypnotic control of the Asurians, he presumed. He recalled the strange transmission of energy from the Asurian's eyes back in Delipho. He looked at the group of hooded figures partly surrounding him.

## II.

"WHY do you not operate?" he queried, breaking in upon their soft interchange of whispers. "My brain is ailing from the fever. I have not very long to live."

"You have a lifetime to live, Bern Gregory," a quiet voice intoned from beneath one of the gray cowl. "Your operation has been a distinct success. You do not seem to be aware of it, in fact."

Bern placed a hand upon his head, felt all over it, yet he could find nothing.

"How long ago was it?"

"You were brought here five months ago by Earthly computation."

Bern stared aghast in contemplation of the length of time gone by. It was unbelievable.

"It seemed like it was only yesterday—or the day before."

"You are well now—entirely well."

Bern swung his feet down from the table and stood up. He was well and strong. A sudden chord of memory made him pause. The last impression his mind had received before he had succumbed to the hypnotic trance returned to him.

"Where is my servant, Jerry?"

"He has been well taken care of," another soft voice assured him, "but you will not be able to see him just yet."

A sense of uneasiness crept over Bern. What had they done with Jerry during these long months? He remembered the dull, hopeless look in Jerry's eyes on that last day in Deliphon. His eyes were drawn irresistibly to the grim and suggestive contents of the transparent jars with their different liquids. He shuddered. What a strange place of sorcery. He recalled the skeleton which had walked. He suspected mechanical trickery of some sort. How else could he explain it?

"What are my duties to be, now that I am well and strong again?" Bern inquired.

"You have already performed your most important duty," was the mysterious reply. "But you can yet prove useful to us. You can never leave us. You realize that."

"Yes, I know it well."

"I shall show you to your quarters," said one of the Asurians.

He led the way through a long corridor with soft, noiseless tread. As they made a turn into a cross corridor, a startling apparition faced them. There stood a great insect with the legs and body of a man. Bern exclaimed in alarm. The thing had human arms, too. The monster's mandibles grated together, opening and closing slowly, the black, beady eyes staring blankly beneath waving antennæ.

"Do not fear it," the Asurian intoned

smoothly. "It is one of the hybrid insect men. There are many of them here."

The priest uttered a few words, waved his arm significantly, and the insect man crept off down the corridor. Bern's flesh crept. What a horrible place this was. What fiendish ingenuity these Asurians exercised. While Bern was thinking about the strange things he had seen in these catacombs, the Asurian led him into another chamber larger than the laboratory they had recently quitted. But for several long benches and a table in the center, it was empty. Many small doors led off from this broad, central chamber. To one of these the priest led him and motioned him inside. Bern entered a small cubicle cut from the rock, finding only a bunk, pallet, and a small bench.

"You will respond to any general call," he was told, and then the Asurian left him alone.

BERN pondered these last words. General call. Then all the little chambers were inhabited. By whom? Others like himself? His thoughts reverted to the insect man, and he shuddered. The Asurian had closed the door as he left, and in the pale light exuded from a composition lining the walls and ceiling of his cell he saw a strong bolt on the door. He would at least be free from any roving monsters of the cult. He reached up to try it. The sleeve of his loose-fitting robe slid up his arm, which he drew back from the door in sudden horror and astonishment.

From his sleeve there protruded the arm and hand of a skeleton. He stared at it in fascination and dread. Cautiously he moved his fingers. The skeleton fingers responded. He closed his fist and thought that he could feel skin and flesh. Slowly he moved his other hand to feel of the first one. A fearful suspicion confirmed itself. Another



bony hand reached out to clutch and feel of the first. But the dry bones he expected to touch never came into contact. They stopped within less than half an inch of each other, and he could feel firm flesh, warm and sweaty from his nervous anxiety. It was all too impossible, and he closed his eyes to escape the dreadful illusion.

With eyes closed, he ran his hands over both arms, feeling carefully of all his fingers and thumbs. No, they were all unchanged. He could feel them. He even pinched the flesh to convince himself of the pain. Then he opened his eyes. There were the skeleton arms and bony hands again. Finger nails standing out independently of the bones finally brought the truth to him. For some reason or other the flesh on his arms and hands was invisible.

A horrible thought seized him. He quickly dropped the rough robe which clothed him and kicked off the sandals from his feet. He staggered against the wall in a daze at sight of the gruesome specter which he was. Bony feet and legs led up to the hip bones of a skeleton.

Instinctively, his hands went to his face, feeling of his head, his neck, his shoulders. Everything felt normal; he could feel no bones. His hands slid slowly down his chest and around over his pelvic bones so clearly visible. Not the slightest haze of flesh could he see. His flesh was invisible.

What damnable machination of the cult had accomplished this infernal trickery? Was it something about the room he was in which contributed an illusory effect? He suddenly recalled the moving skeleton he had seen in the laboratory and which he had thought to be mechanical. What had they done to make him like this? They had broken their promise. They were not to experiment on him. What awful thing might befall him next?

IN mingled fear and despair he jerked open the door and fled into the central chamber. A solitary figure sat at the table. It was the Asurian who had brought him to his quarters. The cowed head lifted slowly; magnetic eyes regarded him somberly.

"I expected you," he said. "I have waited."

"What—what has been done to me?" wailed Bern, lifting his bony arms wildly, revealing his bare skeleton to the priest. "You lied! I was promised immunity from your devilish practices!"

"Peace!" urged the Asurian softly. "The Durna Rangué keeps all its promises. You have not been harmed."

"But my body! I was promised that not a cell of my body would be changed, not a drop of blood spilled! What treachery is this?"

"Nor has a cell of your body been changed, nor as much as a drop of your blood spilled," the cowed figure pursued. "That was the promise, I understand. And you are unharmed. Your flesh has been made invisible. We have experimented upon you. You were not promised definite immunity from that, you will recall."

"But why—why?"

"The Durna Rangué is after the secret of invisibility. Some day it shall be ours, as other things shall also be our heritage. Some day we shall grow to such power as to hold and rule all the inhabited worlds of the solar system. We shall be the guiding star of civilization on its road to Utopia. We may have to wait hundreds of years, but our course is constant, inexorable. We must exercise patience in all things, even this detail of invisibility."

"We have found a way to make the flesh invisible, but treatment of the bones defy us. Other than its being invisible, you will find no changes in your flesh. All bodily organs and glands remain unaffected in their functions. There are many like you here in the

cliffs. We are constantly experimenting with slightly altered formulæ. Occasionally we get varied effects, but success in the matter of making bone invisible is stubborn."

"Shall I ever be like myself again?"

The priest shook his head slowly. "The effects are lasting as long as life remains. When you are dead, a ghost of your flesh will first appear, and then you will gradually return to normal appearance, such as it was.

"But do not despair. What difference does it make? You will never return to civilization. You are one of the cult, one of those ordained never again to see the light of day. Be satisfied, work well, and perhaps you may be given a much longer lifetime than would have been your normal lot in the world of trouble and struggle which you knew. Things are easy here. Things are quiet. Go back to your quarters and be thankful and satisfied."

Silently Bern Gregory returned to his cubicle. He no longer thought of bolting the door. He lay down on the narrow bunk and gave himself over to meditations less philosophic and more troubled than those the gray-robed Asurian had urged upon him.

In the days that followed, Bern found his duties to be trivial, often menial in character. His greatest duty had been done already. He had tested one of the formulæ for invisibility. The many doors of the central chamber led to other little cubicles where dwelt his brethren of similar experiments. He saw them as they saw him, hollow eye sockets staring blankly from grinning skulls. He soon came to take this spectral illusion for granted and thought little or nothing of it.

The effects of these experiments varied in a few instances. Sometimes the bony structure assumed different shades of color, ranging from white to yellow. There were two of the skeleton men less successful in their experimental state

than the others. The flesh of one shone as a dim, indistinct halo. One was very poorly done. In fact, his skeleton was translucent. Every organ of his body could be seen in operation.

THE RANKS of these semi-invisible neophytes had been recruited in various manners. Among them were many of the Venusian troglodytes. Others were criminals who had been given refuge by watchful proselytes on three worlds. There were those who had become dejected with life and had yielded outright to the temptations of the synthetic lifetime held out to them so glowingly. Several had been stolen. The cult had been accused of this practice previous to its banishment from the Earth.

From his companions, Bern learned about many things which had puzzled him. The dwarfs who were so small and strong had once been full-grown men. They still weighed as much as they ever did. The cult had reduced them in size by atom compression. The orbits of the electrons had been shortened. Their great strength they owed to the ingrafting of glands from the giant, Martian ants. The process of atom compression dulled their intelligence.

The dwarfs did most of the heavy work in the catacombs. The skeleton men occasionally helped with the dwarfs in the laboratories. The catacombs in the cliffs were constantly being extended, and this duty fell largely upon the skeleton men, who worked with rock disintegrators, under the able directions of the Asurians.

With more of the skeleton men, Bern once visited an isolated section of the labyrinth which he hoped never to see again. All of the catacombs were depressing and morbid—this place even more so. He had seen the chamber of the coffin baths. This new place was much like it. There were baths here, too, but their occupants were not the dream sleepers of the synthetic lifetime,

They were people abandoned by the cult as useless, held in suspended reserve for vivisection. They worked in a somnambulist state, going to and from their coffin baths to the imperative tones of a bell. It was here that the gray vapor for the coffin baths was made. These doomed individuals of the living dead manufactured it like so many mechanical robots, moving as in a trance.

### III.

FROM TIME TO TIME, Bern inquired about Jerry. The replies of the Asurians were always evasive. He was somewhere in the catacombs. He was not dead. Of that Bern was assured by his superiors. But where he was and in what condition, Bern was unable to learn. He sometimes suspected Jerry to be among the dream sleepers. That he was not in the horrible condition of those who manufactured the gray vapor, Bern was certain, for in spite of his revulsion he had eagerly scanned the faces of those he had seen there.

His eventual discovery of Jerry proved to be the saddest blow he had received since his arrival into the gray cliffs. Bern and more of the skeleton men were at work with the rock disintegrators one day when a group of dwarfs came past with several of the insect men. One of the latter commenced to act strangely.

Bern was talking with another of the skeleton men and did not at first notice the peculiar attention of the black, glistering, insect eyes with the antennæ waving excitedly above them. Then he saw the thing advancing slowly toward him on human legs, arms and hands trembling.

Bern knew that the insect men often went berserk, and he gathered himself for an anticipated attack. One of the dwarfs sprang forward to intervene, and then Bern saw something which made him gasp in surprise. A long, livid scar

ran slanting across the forearm of the insect man. Jerry had carried that scar for many years.

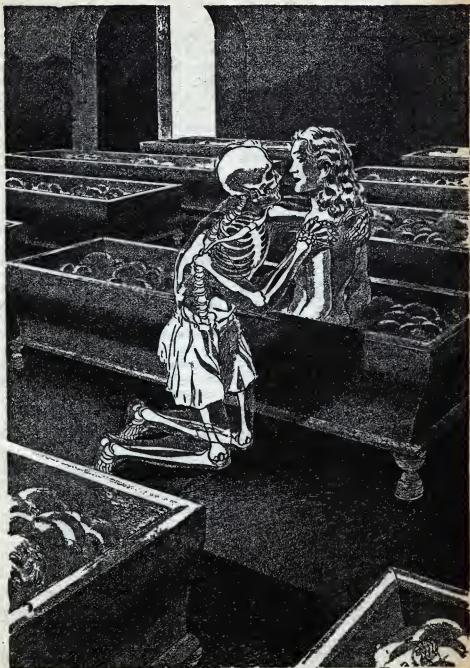
Bern tried to find his voice, but emotion overcame him. His eyes took in every detail of the insect man's human body. It was Jerry. They had done this awful thing to him. Pangs of sorrow and regret seized him as he thought of the gruesome bargain he had struck with the Asurian. He wished now that he had been allowed to die. The price for his life had been too great. Unwittingly, he had brought this terrible thing upon the head of his faithful servant.

Caressingly the hands of the insect man touched him, patted his shoulder. The tears in Bern's eyes would not be denied. They coursed down his cheeks. The beady, insect eyes, however, saw only a vacuous expression of empty eye sockets in a white skull. Jerry had heard his voice and had recognized it. Otherwise, unless Bern had seen the scar on the hybrid's arm, they would never have known each other. The insect men had no voices, only a grating pur, sometimes given a piercing note by effort of the human lungs.

"Jerry—what have they done to you? Do you hear me?"

The hand of the insect man took Bern's wrist and squeezed it in acknowledgment. The others were regarding them curiously. An Asurian spoke softly, and the nearest dwarf rudely separated them and pushed the insect man toward the others, who were slowly returning to their quarters.

The discovery of Jerry had aroused Bern. He wished they might find a chance of escape, but there was no way out other than the secret ways used and known only by the Asurians. There was a known way out, so the skeleton men whispered among themselves, but it lay beyond the cult's aging chambers near the top of the cliff, and no one dared pass through the dreaded place.



*Bern visited the tomblike chamber of the coffin baths—to see her raising her cold body from the prickling gray gas—*

FROM that time on Bern contrived to see Jerry almost daily. Bern did most of the talking, Jerry writing his replies in the dust of the floor with a rod. This they smoothed over again. Jerry was the first insect man Bern had ever examined closely, and he found the head and anterior section of the gigantic insect grafted upon the neck and shoulders of the man. He learned that the bony structure of the human cranium had been removed, baring the brain, which the Asurians had contrived to associate with the insect eyes, mandibles, antennæ and other features of the grafted superstructure. Jerry's jawbones had been deformed to comprise a strengthening portion for the insect head.

What surprised Bern was to find that Jerry now had two brains: a human brain and an insect brain. The human brain remained in the ascendancy, however, unless the insect man became startled or enraged. The Asurians knew how to make the insect brain dominant by exercising their mental control.

One day Bern saw a consignment of human merchandise brought into the catacombs. From an inconspicuous distance Bern looked upon the group and gathered from their frightened, wild-eyed expressions that they had not come voluntarily.

A feeling of bitterness surged over him as a figure, smaller than the rest caught his attention.

A young girl who had probably seen no more than nine Earthly summers stood huddled with the group, her tear-stained face one of despair and dazed terror. Blue eyes stared pathetically at the emotionless, gray-robed figures moving noiselessly to and fro in quiet consultation over the eventual disposition of these new subjects. Her flaxen hair was wild and tousled. She shrank back against an old man who absently mumbled assurance he himself did not feel, for his eyes mirrored the hopelessness

of his soul. In one arm the child clutched a doll.

He watched furtively as the Asurians and dwarfs examined the group, finally urging them along in single file toward a winding stairway which led to a higher level. Bern followed by a more devious and rarely used route. From the protection of a cross corridor he saw the helpless victims of the cult ushered into separate chambers. Pity welled in his heart for these unfortunates, especially for the innocent child plucked from life's bud to become a ghastly, inhuman product of the Durna Rangue.

WHEN the dwarfs and priests had gone, Bern stole softly along the dimly lighted corridor past the doorways into which the new arrivals had been escorted. He paused before one of them. From within, a heart emptied its grief and loneliness in shuddering sobs. It was the child. The dull-witted dwarfs and their soulless masters had separated her from the last vestige of comfort she had known in her plight.

Almost involuntarily, Bern stole inside. A first small room lay empty. Soft, little sobs issued from a darkened room beyond. Bern entered. There was none of the transfusion of light from coated walls and ceiling. Only a dim reflection from the room beyond showed him the figure of the child lying upon the pallet. He stole to her side and placed his hands gently upon her shoulders, his voice comforting.

"Don't cry. Everything will be all right."

"Who—who are—you?"

"A friend."

A small head with tousled hair pressed itself against Bern. "Don't let them get me."

"No—no, of course I won't. How did you come to be here? Where did you live?"

"I live in Mendex. I was playing—and—then somebody grabbed me. I



tried to yell, but I couldn't. They brought me to a ship with other people in it, and they flew here."

The girl had mentioned one of the most remote Martian colonies. Her people were evidently colonists. The space ship had made a tour of the colonies for its victims.

"What is your name?" she asked.

"Bern. What is yours?"

"Loa."

The companionship of the child filled an empty spot in Bern's heart. She was courageous. She was forgetting her grief.

"This is Annie," she said, thrusting an unseen object up to him in the gloom.

He took it. It was her doll. He handed it back to her.

"You and Annie must go to sleep like good little girls."

"Don't leave me!" she pleaded, seizing his arm.

"I must. They'll find me here. Then I can never see you again. I'll come back."

"No!"

A tremor of fear in the voice and the fierce insistence of the small clutching hands melted Bern's resistance. He knew that she must soon sleep, that she had gone without sleep for some time, and he waited resignedly. Nature came to claim her even sooner than Bern had hoped for, and, gently disengaging her arms from his own, he laid her gently upon the pallet and slipped away.

He immediately went in search of Jerry. When he found him he told him of the new arrivals and of Loa. He held forth hopes of escape, of getting her away from the damnable cult and returning her to her people in Mendex. This had become his burning ambition, and he was willing to die in the attempt. In the dull, gloomy catacombs where he was condemned to spend the rest of his days, life held little for him, anyway. There was no great forfeit if he did lose. Jerry, ready to do anything his

master told him, vowed his service to any mad scheme Bern might contrive to get Loa free from the hell of the catacombs.

BERN, true to his promise, returned to the chambers of Loa, making sure first of all that there was no one about to see him. He entered, and she looked up from the small table where she was sitting at a repast brought her by a dwarf. Her eyes grew round in horror. She screamed and tipped back the chair, shuddering and shrinking away as he advanced haltingly, uncomprehendingly. Another of her screams drowned the words on his lips.

He became quite suddenly aware of two things: his terrible appearance frightened her; and her screams would bring an Asurian or the strong, little men running to investigate. He ran out into the corridor and quickly put a large amount of distance between himself and the girl's vicinity. He cursed his lack of thought in letting her see him. Before, they had been in the dark together. The most of him she had seen was but a dim shadow. Sight of his spectral figure had frightened her out of her wits.

It was several days before he again tried to see her. She was sleeping. He sat down and gently shook her to wakefulness. She sighed and murmured questioningly. He spoke, and she recognized him.

"Why have you been gone so long?" she asked. "Why didn't you come?"

"They have kept me busy," he lied discreetly. "I am but a servant here."

"It is so lonely. The little men come to bring me food. A man in a gray robe and hood came once to ask me strange questions. He had awful eyes. They seemed like they were pushing me over backward when I looked at them. And—oh—I saw something terrible! It was a skeleton walking toward me! I've been so scared it will come again! I wish you had been here!"

Bern felt her little arms cling to him comfortingly; he felt the ensuing shudder which racked her body as she recalled the deathly apparition which had been himself.

"Don't be afraid of them," he told her. "They are unfortunate prisoners here the same as you are. They will do you no harm. Only the gray-hooded priests can do you harm. It is they of whom you should feel frightened. The skeletons are really men, only you cannot see anything of them except their bones."

Loa clung to him tightly. The subject was an unwelcome one, and no explanations could reduce her childish terror. Bern believed that the cult was paving the way for another of their grim experiments. That was why the Asurian had talked with her. He decided more than ever to try and find a way out of the hellish maze.

He did some daring exploring into places where he would never have dared gone before. He risked detection which would have meant strict punishment. He questioned his companions of the invisible flesh and learned in a casual, off-hand manner all that they knew. Jerry explored, too. And it was Jerry who brought the first encouragement to Bern's hopes. The inarticulate insect man wrote his message in the dust.

"Have seen daylight near top of cliff. Find passage used only by Asurians. Dangerous and difficult to reach."

#### IV.

BERN went to find Loa. She was gone. Both chambers were empty. The priests had come for her. She was doomed to one of their insidious experiments. A growing fear swelled to horrible certainty. He shuddered as he thought of the living dead who worked out a broken dream existence. There were those more favored by the cult, however, who never left the coffin baths

until their synthetic lifetimes were terminated. He wondered what they would do with her.

From that time on he tried all possible means of prying into her fate. Jerry helped. But they found themselves blocked. They learned absolutely nothing. Neither the insect men nor the skeleton men knew anything of the affair, and if the dwarfs knew, which they probably did, they could scarcely be induced to tell, in spite of their inferior intelligence. It was difficult to approach them. They enjoyed an authoritative superiority accorded them by the Asurians over the other monsters of the catacombs, and they were suspicious, self-sufficient, and unfriendly.

Out of sheer loneliness, he went periodically to the deserted chambers of Loa. The child was gone. Sometimes he found himself actually wishing that she had been taken to the vivisection room, as horrible as the thought was. Death—rather than some ghastly experiment or life in the hellish catacombs surrounded by living monsters of a bad dream—was preferable.

He became accustomed to sitting there in the semigloom and thinking. He thought of the chance of escape discovered by Jerry. He thought also of the mazinite miners who lived on the hill across the valley. If he and Jerry could reach them, they might find protection. But Bern could never leave until he had discovered what the fate of Loa had been. It seemed too much like desertion.

Bern entered the chambers one day, or night, for he never knew which it was, and received a distinct shock. The chambers were once more tenanted. In the dim light, he saw a white-cloaked figure lying full length upon the pallet. He prepared to leave noiselessly, then hesitated. Curiosity overcame him. He took a closer look. A woman, probably a new victim of the cult, lay sleeping. A sudden impulse seized him to awaken

and talk with her. Perhaps he might help her, too, like he had helped the unfortunate child. He hoped that she would not be terrified at his presence. He was glad of the gloom in which he was but barely a shadow. Gently, he shook her to wakefulness.

"Do not be alarmed," he whispered. "I am a friend."

"Oh, Bern! I'm so glad you're here!"

HE GASPED in sheer astonishment. It was Loa's voice but not as he had known it. The childish inflection was gone. Yet this grown woman could not possibly be her. What wizardry, what magic lurked in these subterranean pits and runways to put this wild illusion into his head? Yet here was a woman, a woman with the voice he had come to know. And her familiarity was undeniable. Stricken speechless, he sat there, nerveless, staring at the dim, white apparition she made as she slowly rose to a sitting posture beside him.

"I can't see you very well," she whispered huskily. "They have changed me, Bern. I feel so different. Everything seems to have grown so small all of a sudden. And you, too, have shrunk, like the dwarf. It is strange. My mind is changed. I seem to know more than I did. There are strange impressions on my mind. I catch myself even talking differently now. I feel older. What have they done to me, Bern?"

"Loa! Good, Lord! You've been to the aging chambers! You're no child any longer! You're a full-grown woman!"

"Was that what that place was? A dwarf carried me inside and left me on a dais; then he left and the door closed. Everything around me turned a deep blue, even the air, and I could see nothing. There was a terrible, deep throbbing all around me, and I could feel every cell of my body responding. Oh, it was a terrible feeling. And when the light was gone and the throbbing

hum was once more silent, the dwarf came in and brought me out. Everything else seemed to have shrunk, but I guess it was just that I got bigger."

"They did that to you in a very few minutes, Loa. Your body was forced through a concentrated environment and was subject to rapid cellular metamorphosis. If they had left you in there three times as long as they did, you would have emerged an old, gray-haired woman. One can die of old age in those aging chambers, if they are left there long enough. What else did they do to you? You are changed mentally, and the aging chambers do not develop and educate the brain."

"I don't really know. They forced me under a spell of theirs, and I was on what was probably an operating table in one of their laboratories."

"It is evident that they brought your mental faculties into balance with your increased age. They are devilishly clever at brain operations. That is why I am here. They found me close to death from a brain ailment. It is even possible that small parts of other brains have been used to replace minor portions of your own."

"I—I can easily believe that, for there are dim, hazy recollections and impulses I have never before experienced."

"I wonder how old you really look, now," mused Bern, more to himself than to Loa.

"Come out into the other room and see," she urged him, taking hold of his arm. "I've never seen you, either, Bern."

"No—please don't!" His voice rang with the sudden apprehension which seized him. "I am a monster!" he told her with desperate truthfulness. "I would horrify you! You would shrink from me!"

"Bern," she said softly, "I would never fear you. Why do you talk like this?" Her hands meanwhile played

caressingly about his head and face, an unconscious impulse foreign to the child she had previously been. "My brain is not so changed as not to recall how nice you were to me, and that you are all I have here. Why are you afraid to have me look at you?"

"Because I am not exactly what I seem like," Bern spoke despairingly. "The cult has made my flesh invisible, Loa. I'm that terrible skeleton figure which terrified you and made you scream. I came to see you, forgetful of my startling appearance. After that, I was careful to come and see you only in this darkened chamber."

He felt the girl start involuntarily at memory of the animate, deathly figure which had come striding into her chambers. But she quickly recovered, and her attention was even more solicitous than before.

"But, Bern, you are no monster. You are not changed physically like some of the horrible things I have seen here. Come, do not be afraid to let me look upon you. Now that I really know it is you, it makes all the difference in the world. Besides, don't you want to see me?"

THERE WAS enticement and allure in the last suggestion which thrilled Bern strangely. He did want to see her. He desired strongly to look upon her. The child had been unusually attractive. What could the woman be like? Yet above this desire there lurked the stronger fear that Loa would be repulsed and horrified by his sepulchral appearance. He allowed her to lead him into the other room, where they stood revealed to each other.

His first impression of Loa, the woman, caused him to catch his breath. She was ravishingly beautiful beyond his most imaginative anticipations. Sight of her caused him to forget, momentarily, the bitterness and shame of his deathly countenance.

Her face was like a delicate flower, pink and white. Starry, blue eyes were distended in awed fascination as she regarded his terrible appearance with parted lips. He stood before her, his bones apparently naked of flesh. Her breasts rose and fell to faster breathing, as she advanced to him fearlessly and stared wonderingly into the empty eye sockets glaring back at her above the rough hole for a nose and the merciless grin of naked jaws.

Bern, too, was breathing faster. An invisible tear crept down his cheek and splashed on Loa's slowly lifting arms. Gently, her hands touched his bare, warm flesh, and there crept into her startled eyes an expression of reassurance. The soft arms slid up about his shoulders and around his neck. The perfume from the waves of her shimmering, flaxen hair assailed him with an ecstatic dizziness he had never known before. And then he felt her against him and his arms went about her.

Loa's eyes closed as her head came nearer the ghastly death's head which was his own, and her warm lips found his invisible ones caressingly. Bern found himself uplifted, from the gloom of despair and faltering hope, to joy's highest peak. He knew that he loved Loa and that she was his. Her arms clung to him tightly, instinctive with love and surrender. The Asurians had done well in correcting the defects of the aging chamber. Loa was all woman. Only her childish innocence remained.

How long they stood there, they never knew. Love knows no time; heart ecstasy, no surfeit. Between murmured endearments, Bern spoke hopefully of escape, telling her of Jerry's discovery. He would dare anything, now. If they failed, he told her, they could take their lives together. Death would be merciful in comparison with the vengeance of the Asurians. The end of their tryst came with the sound of scuttling footfalls in the corridor.

Alarmed, Bern crept into the darkened chamber, to avoid discovery, afraid to breathe lest he be found and their dreams of escape abruptly shattered. He heard the querulous voice of the dwarfs as they entered the outer chamber where Loa waited.

Bern stood in a corner darker than the rest, like the shadow he almost was, the color of his bones merging with the harmonizing shade of the gray walls. Then he heard the sibilant and low-spoken commands of an Asurian. Silence, complete and ominous soon reigned outside. When he looked a short time later, he found the chamber empty. Loa was gone. They had taken her again.

His heart chilled with dread. What terrible iniquity were they going to perpetrate on her loveliness? He clung to a dim hope. They had taken great pains to age and advance her intelligence to that of an adult. If it were physical parts they required, they would never have troubled themselves with her brain operation. He and Jerry must plan their chances of escape just as soon as Loa was restored to her rooms once more.

Bern visited the deserted chambers oftener than before. Loa was never returned to them. He searched for her wherever he dared. Jerry was ever on the watch, too, his dark, insect eyes vigilant. It was he who assured Bern that Loa was not among the living dead. He had gone there and investigated.

Bern began to foster a suspicion that Loa had been immersed in a coffin bath, enjoying a synthetic lifetime until the Asurians saw fit to use her for an experiment. As disgusting as the search promised to be, he, nevertheless, steeled himself to the task. If he found her in a coffin bath he knew that it would be on the seventh level, next to the laboratory where the dream sleepers were prepared and resurrected.

## V.

He LOST no time in availing himself of the first opportunity to get into the broad chamber. The laboratory at that time, he knew, was deserted. Long rows of coffin baths, open and more than half full of the misty, clinging vapor, filled the floor space of the rock-hewn chamber. Under the gray gas lay the dreamers in their synthetic lifetimes.

The symbols on the foot of each receptacle, although designating the person within, were meaningless to Bern. A fine coating of dust covered the edges of most of the receptacles, and he knew that the one in which Loa lay was not one of these, for she had been immersed, if at all, recently.

He found a bath on which the dust was disturbed by recent handling. With hesitant reluctance, he slowly sank his hands and arms into the heavy, gray gas. A peculiar, numbing feeling prickled the epidermis of his hands and arms. His groping hands found the body within and raised it to a sitting position. The gas slipped slowly off the head and shoulders, to reveal a man, his face set in a mask of death. Slowly, Bern let the body sink back to rest.

From bath to bath he went, plunging his arms into the gray vapor wherever he saw that the dust on the receptacles had either been disturbed or else was noticeably lacking. He no longer troubled to raise each dream sleeper for inspection. His groping fingers lightly touched each head and face. He would know Loa in this manner, if he came upon her.

And he did. His heart made a queer jump and commenced to beat swifter. Trembling in every fiber and scarcely conscious of the numbing sensation from the tenuous vapor, he drew the girl to a sitting position. Her flesh was cold. The clinging gas rolled sluggishly from her head and shoulders, and he saw



Loa, her face set in a quiet, peaceful expression as though she were dead. Only the relaxed muscles of her body contradicted her obvious appearance. He knew that the synthetic lifetime was closer to death than to life. Even in her deathlike trance she was beautiful, and he gazed upon her with eyes of love and worship. "What was she dreaming?" Bern wondered.

A faint sound from somewhere caused him to let her down again into the gray vapor. He hid behind a near-by pedestal supporting another bath. He heard nothing more and crept silently from the chamber, working his way back to the quarters of the skeleton men by a devious route. He saw Jerry later and disclosed his information. Their plans of escape were definitely postponed until Loa was brought out of her synthetic lifetime by the Asurians. How long this would be, he had no way of knowing. It might be months, perhaps years.

In the days which followed, Bern occasionally visited the tomblike chamber of the coffin baths to see his lover, raising her cold body from the prickling gray gas to look upon her lovely face, with its closed eyelids and long lashes. The chamber was rarely visited, and so no one ever viewed this weird spectacle of a skeleton worshipping a corpse. In these silent communions, Bern longed for, yet awaited patiently, the day of her resurrection, when he and Jerry might take her on their desperate dash for freedom.

A DAY CAME when the catacombs were rife with excitement and conflict. The Asurians had lured the wife of the mazinite miner into their grim galleries, and the husband and another man had invaded the place to reclaim her. In spite of the electric pistols and mind protectors of the two invaders, they were taken, after a fierce battle. Bern had not taken part in the fighting. He had

been detailed with others to guard a passage. The two who were conquered were temporarily consigned to the coffin baths.

Bern heard of the grim battle from the skeleton men who had participated. Their tale had not been fully recounted before the alarm sounded again, sending them running down the corridor to meet an impatient and plainly unnerved Asurian. The trouble had subsided only to rise again. Sinister forces, adverse to the Durna Rangué, were at large in the catacombs. There was fighting on the seventh level. Dwarfs and insect men joined the hurrying group. Bern found Jerry. They kept together.

Several Asurians were waiting as they ascended to the seventh level. There was a hasty consultation of the gray-robed brethren.

"The laboratory and the chamber of the dream sleepers has been barricaded! Some one is reviving our neophytes just as fast as the process permits! Their numbers are becoming large and formidable! They are rebelling!"

Resurrection and insurrection. The similarity of these words rang oddly in Bern's mind, as he hurried along with the others. How he hoped this arch-enemy of the cult succeeded. Resurrection meant the return of Loa to normalcy. Insurrection magnified the possibilities of escape.

They met several skeleton men and dwarfs coming down the corridor leading from the barricaded laboratory and chamber of the coffin baths. One of the former carried information.

"The green death is driving them all out of the laboratory and into the low passage near the ceiling! They are all leaving the laboratory!"

The Asurians acted instantly. Dividing their forces, they took with them the greater part, sending the rest to guard all entrances to the laboratory and chamber of the coffin baths. The re-

enforcements, of whom Bern and Jerry were a part, hurried to join the desperate and bloody battle between awakened neophytes and the cult's monstrosities. The neophytes were pouring out of the low tunnel and into a broad chamber, where the cult's minions awaited them.

The neophytes outnumbered the monsters, but the latter were partly armed. A few of the skeleton men wielded cutlasses. The tremendous strength of the dwarfs was an important factor, but above all the spitting electric pistols, which the two mazinite miners had recovered, held the advantage.

Many of the newly revived neophytes carried heavy instruments picked up in the laboratory, belaboring the cult's monsters with telling effects. Tersegs flew croaking and screaming above the mêlée. Afraid of the electric pistols, the priests of the cult kept discreetly to the background.

From a distance, the Asurians attempted collective mind force, but without avail. Any close appearance immediately brought an electric flash from one of the two watchful mazinite miners, who realized their greatest menace. The dwarfs, however, were turning the tide of battle in favor of the cult. Unnoticed in the confusion, they crept in among the legs of the combatants, seizing the lower limbs of the neophytes and pulling them down.

The neophytes, headed by the mazinite miners and an attractive, brave-eyed woman in male attire, were aware of their disadvantage and were fighting their way clear of the congested chamber through a partly blocked doorway.

BERN'S EYES roved questingly among the neophytes for a sight of Loa. His hopes fell. He did not see her. She had not been revived. Yet he could not see all of the neophytes. Some of them had been knocked down, many

trampled. In fear and anxiety, he worked his way around the outer fringe of the cult's fighting demons.

He raised his eyes suddenly and saw Loa. His heart stopped beating momentarily, then increased its tempo. She stood in the tunnel near the ceiling, through which the neophytes had come from the besieged laboratory. A loosely fitting robe shrouded her body. In alarm and bewilderment, she stared down at the surging maelstrom of fighting forces.

Desperately, Bern fought his way toward her. A neophyte hacked at his head with a long rod. He avoided the blow, partly catching its force upon a hastily uplifted arm. A dwarf stood in the way. He climbed over him. The little man glared up belligerently at him, but recognized one of the skeleton men eager to get into the fray and do his part. When he was closer, Bern shouted to her. "Loa!"

She stared at him, recognized his voice and gave him a quick, little smile. He pushed his way in under the tunnel opening.

"Drop down, dear."

A neophyte made a desperate lunge at Bern, thinking to protect the girl the skeleton man was trying to reach. It was watchful Jerry who frustrated the effort, seizing the man's arm in his mandibles and giving it a vicious tweak before releasing it and hurling him backward.

Loa dropped into Bern's arms. He carried her toward the nearest exit, while Jerry kept off all attempts of the well-meaning neophytes to block their path and regain her.

Through the tightly packed ranks of the dwarfs, skeletons and insect men, they pushed their way, accepted as friends who had captured a neophyte and were returning her to the Asurians for hypnotic control. They finally won through to the doorway. Jerry led them

quickly to the highest level, where he had discovered an escape from the catacombs. There was no one to block their escape. They were all too busy fighting the rebellion.

A strange light, stronger than the artificial illumination of the subterranean chambers filtered into a passage through which Jerry led them. They walked into the beauty of natural daylight through a small opening just below the edge of the cliff top. The valley lay below them. Across the valley rose a hill. On the summit, among its trees and shrubs, nestled the home of the mazinite miners.

THERE WAS no time to lose. Bern picked Loa up in his arms, and he and Jerry made their way down a tortuous path into the valley. Several times they looked back, but they neither saw nor heard anything alarming, until they reached the foot of the cliffs. They heard excited cries echo across the valley from the cliff. Bern wondered if the neophytes had won their way to the summit and discovered a way out. It would be best to hide. They hurried beneath a ledge fringed with bushes.

"What miracle recalled you from the synthetic lifetime, Loa?" Bern asked, drinking in her loveliness with invisible eyes. "How did they ever bring you back? I understand that it is a complicated process."

"Not so complicated but what the woman secretly watched the priests at work and later used the process in recalling both her husband and his friend from the dream life into which the Asurians had placed them."

"What woman?"

"Clea Santon is her name. She is the miner's wife. At her instruction, others of us who were revived helped bring more of the neophytes from their coffin baths. Then a green fire spread in the laboratory and drove us into the tunnel. It was——"

Jerry emitted an excited croak and gesticulated with waving hands, pointing to the sky. A space ship sailed off and away from the cliffs.

"That ship is headed for Fomar!" exclaimed Bern. "And it is no craft of the cult, either!"

"It is probably the supply ship of Kern Hilton," said Loa. "He was the other miner. He told us that if the neophytes could reach his ship they would be able to escape."

"Let's hope they did."

"If they do, the cult is doomed."

"What shall we do?"

"It is not safe yet to venture forth. We must wait until nightfall."

When night came, they climbed the hill by the faint light of Deimos, the lesser moon of Mars. Phobos rose and moved slowly across the sky. It was Jerry who first saw the long, ghostly line of space ships rising up out of the cliffs and sailing across the moonlit sky. He urged them into the bushes on the brow of the hill, motioning them dumbly for silence.

Bern and Loa gazed wonderingly at the silent ships crossing the sky and dwindling from sight among the stars. They watched, as, from time to time, another ship, or group of ships, rose noiselessly from the black pit in the towering cliffs across the valley and followed the others.

"The cult," whispered Bern to Loa, who clung to him in apprehension. "They're leaving to escape the retribution which will come to them swiftly if they stay."

"Then we need never fear them again," breathed Loa in relief.

"We can stay in the cabin on the hill up above," said Bern, "until those who escaped return with help."

Jerry said nothing. His black, insect eyes watched the space ships drift away, like phantoms, into the moonlight.

# Planetariums

*One year ago this month I suggested that as many of our readers as possible attend at least one lecture at one of the nation's planetariums. I wonder how many have made it a point to do so?*

*Naturally, it is my desire that as many people as possible gain the utmost enjoyment from science-fiction. To gain the most enjoyment we must appreciate the universe of which we read. And if we can visualize the system in which we live, that new knowledge will keep the edge of our enjoyment more than I can express.*

*We have avidly followed John W. Campbell's series on the planets of our universe. We know something of the facts which surround us. Supplement this knowledge by watching these same planets course their way across the sky in a night which occupies only six minutes, and you will gain a new conception of the glories of the galaxies.*

*The Hayden Planetarium, attached to the American Museum of Natural History, in New York, contains, in addition to its main attraction, a tremendous collection of meteorites. These visitors from outer space are messengers from the unknown. They whip your imagination to the point where you can come back to science-fiction with a new sense of reality. These bits of metal have traversed the very skyways we read about.*

*If you live near a planetarium, visit it. If your vacation takes you to a city which has one, make it a point to attend. It will be something for you to remember and talk about.*

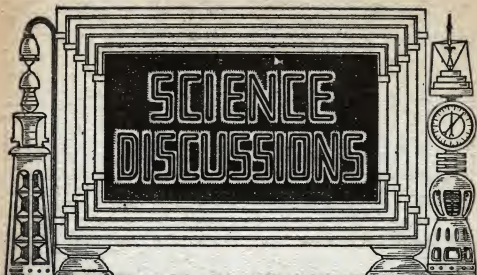
*The controversies in Science Discussions are reaching such a peak of letter reactions that I must mention it. I wish it were possible to include all the letters—but there just isn't room. So I try, in all fairness, to present a complete exposition on both sides of every subject—and to include as many contributions as space allows.*

*Our reading circle, intimate as always, is still expanding, and interest seems to keep pace with the expansion in numbers. I hope that will always be so.*

*Right now I'm planning with fresh enthusiasm, for the summer and fall issues will reach new heights of interest.*

*Tell a friend about Astounding this month. Will you?*

*The Editor.*



# SCIENCE DISCUSSIONS

## AN OPEN FORUM OF CONTROVERSIAL OPINION

Page Mr. Loomis.

Dear Editor:

I fail to see what possible justification Battell Loomis can find for undertaking such an article as *The Talking Hill*, relying entirely upon his admittedly faulty memory. Perhaps if he had known just how faulty that memory of his is, he would have been deterred. And perhaps if he reads this letter, and thereby discovers how faulty that memory is, he will be deterred from similar rash undertakings in the future. Surely in an article described as a science article on the Great Pyramid, we, your readers, are entitled to accuracy and some show of logic!

To begin at the beginning: I seriously doubt that Mr. Loomis has studied even the brief bibliography he has outlined. If he has, I cannot understand him making such a blunder in the description of the most important of the few works listed, viz., that by David Davidson and H. Aldersmith. I have in my possession several copies of this monumental work, but I was unaware that it was ever published in three volumes. It is now in its 6th edition and while I have not a copy of each edition, I have copies of some of the earliest editions and one copy of the latest (1938) edition. There is practically no difference between them. Each edition in my possession is complete in one volume.

I was also unaware that David Davidson was a clergyman and H. Aldersmith an engineer, being, in fact, under the impression that precisely the opposite was true. If letters mean anything, perhaps I am right, for I see Davidson's name followed by M. C., M. I. Struct. E. and Aldersmith's by M. B. (Lond.), F. R. C. S.

Mr. Loomis states that the Pyramid stands  $30^{\circ}$  E. of Greenwich and at  $30^{\circ}$  N. latitude. Later he makes the statement that the sun was directly over the point of the Pyramid at noon of the summer solstice. It's grade-school stuff to see the absurdity in that! The actual N. latitude of the Great Pyramid is  $23^{\circ} 27' 31''$ . 68. It might be added in passing that the truth of Mr. Loomis' statement is further belied by the fact that the Great Pyramid never had an apex, except geometrically. It was left by the builders with a flat top. It is true, however, that the

sun is directly over it at the summer solstice, but not at  $30^{\circ}$  N. latitude!

It was news to me that the Great Pyramid was over 500 ft. high, as I was taught that it was 484 ft. 11.39 in. high. This measure is accurate, as it depends upon geometrical considerations entirely, the present dilapidated state of the Pyramid not lending itself to precise measurement. Incidentally, that measure given includes the missing top.

If, as Mr. Loomis states, the summer solstice (mid-summer's day) was the time when sowing could be begun in Egypt, then he should have added that the Egyptians were very good swimmers. The summer solstice is the time at which the Nile begins to rise. According to Herodotus' observations this rising began precisely on the day of the solstice and continued for 100 days thereafter. Modern observation shows he was approximately correct. All of which is indicative of a very fine sowing season!

If what I have described so far is not enough to justify the wrath of a well-informed student of the subject, then the following is: I quote, "Deduction is a legitimate practice of the wits, but I am less foolhardy than to assert that the Franco-Prussian War began in 1870 because at a certain number of inches along a Pyramid corridor a jog occurs in some masonry." With that statement Mr. Loomis reveals himself completely, in so far as his knowledge of the prophetic theory of the Pyramid is concerned.

I am reminded of a remark made by the press concerning H. G. Wells. It was recorded that Mr. Wells was suffering from a cold which had required medical attention. The paper added that no doubt when he recovered, Mr. Wells would undertake a two-volume outline of medicine! I trust the relevancy is obvious!

The Pyramid entrance passage, according to Mr. Loomis, pointed to the star Capella, which was at that time the Pole Star. It is to his credit that he adds the phrase "If my memory does not fail me." The fact is his memory did fail him rather badly at this juncture. The declination of the star Capella is plus  $45^{\circ} 52'$ , and if that was the Pole Star about 2,500 B. C. then, by golly, that pole has done some stepping! Actually the Pole Star at the time in question



was Draconis, at which the entrance passage of the Pyramid was aimed.

But to return to Capella, Mr. Loomis has depicted it as the head star of its constellation, which he calls Cepheus. If Capella is in the constellation Cepheus, she has been on a spree since I last saw her. The constellation Mr. Loomis is thinking of is, no doubt, Andromeda. But, alas! Even with this correction the data given is still hopelessly incorrect. Capella is not the head star of the constellation at all. In Mr. Loomis' quaint little diagram it would come just at the left-base point of the Pyramid, not at the apex, where he has so conveniently located it.

Space is too limited to continue pointing out the absurdities in Mr. Loomis' article. But, Mr. Editor, please, I beg of you, strive for accuracy in your science articles. A science article on the Pyramid would indeed be interesting, but please obtain it from some reliable sources. Incidentally, I feel that you owe us just such an article, having made the unfortunate error of publishing *The Talking Bill*, and I'm looking forward to seeing it. Yours as a constant reader—despite it—Sutherland Maclean, 162 Eglington Avenue E., Toronto, Ontario.

### E. E. Smith Will Be Back This Year.

Dear Sir:

Spring begins to-day—this evening to be exact—and in spite of snow, sleet, and virus-engendered colds, my blood is bubbling in anticipation. So much so that the battle with Mr. White seems to have gone into a hiatus, I find myself impelled to take issue against the anonymous "C. T. C." of St. Louis, for all writers, including myself.

To go into such a thing properly would require more than a mere letter, and certainly a bit of simple math. May I hereby suggest that John W. Campbell, Jr., follow his present most excellent series with a consideration of some of the simpler mathematical relations involved in celestial mechanics? He can do it, and in a way that would be every bit as readable and informative as the current articles. He knows his ground. That counts for a lot.

I will not evoke mathematical formulae directly to refute C. T. C. Instead, I will quote some figuring of my own, and wait for some one to demand the proof, or Mr. Campbell to give it elsewhere. For C. T. C. is all wet—or at least a bit misinformed as to the fundamentals of physics. But to begin.

For simplicity's sake, I have neglected the curvature of the Earth or any other planet, and the change in direction of the gravitational attraction, the rotation of the planet, and all those things that go to make up an astronomer's headache. To be perfectly frank, I couldn't handle them without a lot more study and refreshing of my memory of calculus than I have time for. But no one who knows his physics will argue with me. I hope, when I say that the same principles of motion will be involved if I speak of a projectile moving in a plane, with the attraction of gravity always downward. This is the simple case of the physics books.

From Newton's first law, that the force acting on any body is equal to its mass (not its weight) multiplied by the acceleration which results, all the other relations for the motion of a thrown ball or a jumping man can be worked out rather easily. Again, to simplify things, I will take a special case—that in which our man (or baseball) "takes off" at an angle of 45°. This is easier to work with, and is the case in which he attains the greatest horizontal distance in his jump for a given velocity of take-off. Presumably, that is what our cross-country jumper on the Moon are after, whose antics cause C. T. C. so much pain.

A few fundamental facts emerge as soon as the equations are set up! First, the speed in a horizontal direction does not change; your upward speed is slowed down by gravity, and your flight stops when you hit the ground again. You will reach the summit of your jump—the point

highest above the ground—just halfway to the finish point, and in half the time that it takes you to get there. You land with exactly the same speed as that with which you took off, except that you are coming down instead of going up. And, under these conditions of a 45° take-off, the horizontal extent of your jump is 4 times the vertical distance which you reach.

These things will be true so long as you follow the conditions which I have set, no matter what the gravity is, so long as you have enough strength to overcome it and make any jump at all. However, the magnitude of the gravitational attraction does enter the equations, and determines how far and how fast you go.

On a planet with only half the gravitational attraction of Earth, if you take off with the same speed as you would on Earth, you will jump twice as far, and it will take twice as long before you hit the ground again. You will hit with exactly the speed with which you took off, whether on Earth or any other planet. On a planet like Jupiter, with twice the gravitational attraction, you could go only half as high and half as far, and would land in half the time. But you would weigh twice as much, and the shock might be hard on your legs, which are not controlled entirely by the laws of high-school physics.

Let us look at some figures. I will admit to having put values in my equations which made them easy to work with, but the same results would come out with any set of figures, actual or imaginary. On Earth, the gravitational attraction is given by a coefficient of 32 ft. per second per second. If Mr. X—or Mr. C. T. C.—takes off at a 45° angle, with (equal) vertical and horizontal velocities of 20 ft. per second, I say that he will sail through the air for a distance of 25 ft. horizontally, and clear a bar 6.25 ft. high at the peak of his flight. He will land 1.25 seconds after he takes off. He will come down at a 45° angle, also, with vertical and horizontal speeds of 20 ft. per second.

Now he takes a trip to Mars, or some other place where the gravitational tug is only half as strong as at home. If he jumps at the same initial speed of 20 ft. per second at the take-off, he will roll over the bar at 12.5 ft. and land in a cloud of dust 50 ft. away—in 2.5 seconds.

On the Moon, with a sixth of Earth's gravity, he would clear 37.5 ft. and make a broad-jump record of 150 ft., all in 7.5 seconds. And he would always land with the same speed as he took off—20 ft. per second. If he jumped at any angle other than 45°, he might go higher, but not so far, because he would either be devoting his energy to leaping almost straight up—neglecting the breadth of his leap—or by flinging himself out horizontally his upward speed would not be enough to keep him in the air. I wish I could draw pictures to illustrate my point. Maybe Mr. Campbell can, some day soon.

Now, about "floating down." That is just what would seem to be happening—clocked on a stop watch. Mr. X takes off with the speed which would carry him 25 ft. in 1.25 seconds on Earth, but instead finds himself in the air for 2.5 seconds and landing 50 ft. away. His horizontal speed is the same on both planets, and he would seem to "come at you" just as fast, but there is less gravity to slow down his upward speed, so he goes soaring up and floating down.

On Earth, for such a 50-foot jump, he would have been in the air only about 1.8 seconds. You may not call that floating, but, especially as you increase the time involved, it becomes more and more noticeable—from the Earthly point of view. To the Martian or Lunatic, of course, those times for those distances would be quite normal—the abnormality would be in the feeble tendencies of the jumper.

One final, worried word, and then I will leave everything up to Mr. Campbell and his yet-to-be-born series. That is the question of the initial jump: on a heavier planet, weighing maybe twice as much, could a man take off with the same velocity that he could with equal effort (let us say his supreme effort) at home? You're right. He couldn't (I'm speaking to C. T. C.). And I can't say by exactly how much he would

fail. I have made a guess, however, and you can have it for what it's worth.

Our Mr. X exerts a certain amount of muscular force—the greatest amount he can—during a very short interval of time. As a result, he not only overcomes the gravitational drag on his body, but accelerates it to the speed of 20 ft. per second, which I have been talking about. The question, then, is this: to what speed could he accelerate his body, using the same force for the same minute instant of time, if the gravitational force was not the same? And what difference would this make in the distance he could jump, and how long it would take him to complete his trajectory?

Again, if you assume simple things, you can get answers which, exact or not, are comparable. If you decide that Mr. X exerts his muscles for one one hundredth of a second, which is somewhere around the probable time, it turns out that with only half the gravity holding him down he would take off only .2 ft. per second faster. He weighs less, you see, but he still has the same inertial mass to overcome. On Jupiter, with gravity twice as large, he could make only 19.7 ft. per second, and on a hypothetical planetoid or satellite with one tenth of Earth's gravity, Mr. X would zoom away at only 20.3 ft. per second instead of 20. In that respect you—C. T. C.—are on the right trail.

Science-fictionists have given the wrong explanation. Using the same muscular force for the same time, a man on the Moon or Mars can reach a speed only a fraction greater than he could on Earth, because, gravity or no gravity, he has the same amount of matter—mass—in his body. In empty space, far from all things massive, he could do only 20.32 ft. per second. However—and here science-fiction is vindicated—that same speed would carry him twice as far and keep him spraddling in the air twice as long. Try it some time, when rockets to the Moon are less expensive.

Another last word. Many thanks to Mr. White for his bibliography of Atlantis. I've wanted such a book list, and I'll look them up. He at least submits his source literature, if the late Colonel Churchward wouldn't. As co-defender King, bouquets for a fair-and-square statement regarding arguments and arguments.

Culture growth in the Americas seems to have been pretty slow, save in a few favored spots, and I think that your anthropologist friend might be willing to argue for a theory which brought the first Americans down out of the icy arctic too fast for cultural evolution, until they sat down somewhere and did a bit of thinking and inventing. Eskimos up there, it would seem, slid downhill. Hrdlicka's oldest finds seem to show higher culture than at any time in recorded history.

I am on the side of the ancients myself—hope that we have some of them here in New York State, and would be glad to champion Abbot's Trenton finds (though not as paleoliths)—but I balk at the process of drawing outlandish conclusions by applying one of a number of possible trains of logic to a set of unconfirmed and non-confirmable facts. That is why archaeology moves so slowly: first, the facts are hard to read, and second, it takes a while of a lot of work to record a fact accurately and finally.

Disbelievers like myself can do more for Churchward and Churchwardians by attacking them, because the only attack can be at the source, through reinterrogation of basic data. And if those data are what they are claimed to be, science will prove it in terms that will stand up under any fire. Don't be fooled into thinking that an archaeologist isn't tickled at finding something beautiful or unusual in the middle of a dry's dig. You should hear him talk about it later. The difference between him and a layman is this: he pinches himself before shouting about it, and maybe—just maybe—he finds that he was dreaming.

Give us sermons again, particularly John Taine. Twelve Eighty-seven was not a good sample of what he can do; it was for the few, with some knowledge of chemistry necessary to realize the full suspense. The kick for me was in his revelation of the nature of his fertilizer—not the

ramblings of the plot—and there many readers would be lost. Have E. M. Smith with something like his very human *Space Hounds of I. P. O.* Have Campbell in more than a few articles. We're headed for the same old trouble in which story value is lost in the necessity of piling crag on crag of outrageous pseudoscientific improbabilities, which will some day stretch the credulities of even the most faithful fan. Some of those—certainly, for thinking and argument—but more yarns dealing with human problems that are good as stories, and have sound science to boot. The best stories haven't always been those that shouted the loudest that they were revelations of an incredible future science.—P. Schuyler Miller, 302 South Tea Broeck Street, Scotia, New York.

## More About Atlantis.

Dear Mr. Tremaine:

As I seem to have become a monthly contributor to your Science Discussions Department it seems that I must once again take my pet in hand (or should I say my cudgel?) in defense of Atlantis. I have just purchased your April issue, in which my Atlantis bibliography appears. At the time I mailed you this list of books and its accompanying comments I had not yet read the two lengthy refutations on my pet theory by the New Yorkers, Dr. Clark and Mr. Miller, as published in your February issue.

Having resided in the Empire State for some four years, and knowing a great number of its citizens, I realize how futile it is to attempt any argument with New Yorkers. Their egotism and knowledge on matters concerning practically any subject is too well-known to be commented on here. Though I still fail to see that either of these two gentlemen have broken down what Mr. Claire Beck has been kind enough to call my "essay" in the December issue; perhaps it is because I may have acquired a little of that metropolitan ego myself, during my brief sojourn there.

It is not my intention, however, to enter into a long-winded debate with my two friends, and anyway I note that Mr. Emory King has kindly gone to bat for me in the current issue, for which he has my heart-felt thanks. There is but one thought which I would like to leave with my readers before signing off: The average man of to-day is not the civilized superman that we of the 20th century would like to believe. Place him upon a desert isle and he would revert to barbarism in a comparatively short space of time. His civilization is handed to him on a silver platter by the few brilliant intellects who invent the luxuries he enjoys and write the thoughts which his mind absorbs.

For instance, I know practically nothing of airplanes. Assume that a catastrophe should leave me, and a few more like me, stranded with nothing but our hands to rebuild our vanished civilization. Do you believe that I could build a plane, or that you could, assuming that you know no more about it than I? Or a radio? Or a motion-picture camera? We might even have the materials and tools and still not be able to do it. We are average citizens. We know naught of such things. We use them now because they are here, because some one more intelligent than we are has given them to us.

Now let five thousand years slip by. Wouldn't you say that our descendants, yours and mine, might have racial memories of machines that could fly, even as the ancient Greeks remembered good old Daedalus and his wings? Wouldn't you say that in those generations our children would have to descend to the depths and rise again, to produce once more the intelligence that would touch our peak of to-day?

Why even a man-made catastrophe, like the collapse of Rome, brought on a Dark Age that set mankind back on its haunches nearly a thousand years. What must have occurred to humanity when Atlantis fell? The surprising feature is that man came back as quickly as he did. Atlantis submerged in 9,000 B. C. By 6,000 B. C. we have vestiges of written history.

Only three thousand years elapsed, while man rose again from savagery, a mere day in our history, yet long enough for him to forget his earlier glory or invest it in supernatural imaginings, to make gods of his ancient kings and fairy stories of his earlier history.

The Bible tells us that before the flood a mighty civilization flourished. At first it was good, then it became wicked and the deluge destroyed it. What is this but the destruction of the Atlantean civilization by water and "the fires of the underneath"?

Plato tells us that the empire of Atlantis existed for thousands of years at peace with the rest of the world and within its own boundaries. But the cankersores of its own prosperity and indulgences ate into its vitals, and Atlantis was destroyed for its sins.

Incidentally, to those of you who took me to task about Plato and informed me that he was obviously spinning a yarn, I would like to say that I was under the impression Plato was telling a story which he assumed was true and which he had obtained from his ancestor, Solon, who had, in turn, received it from the Egyptian priests at Sais, in the delta. As it is a historical fact that Solon did visit Sais, one of the oldest of Egyptian cities, I can hold no brief in the assumption that Plato was merely writing an earlier version of Sir Thomas Moore.

I am well aware that I am eulogizing an unproven theory and that I can be, and have already been, "snowed under" by an avalanche of "facts," but, after all, to-day's facts are to-morrow's fiction and by the same token to-day's history is to-morrow's mythology. Much of the early part of our present history is shrouded in myths. So who can tell if, seven thousand years hence, some Eastern fact fancier may not write a lad out West in Kansas to inform him there never was a dust storm there, or that if there was a mythological war fought in the early 20th century an ancient empire called Germany won it?

The Atlantis theory eliminates so many question marks for me and explains so many fascinating myths that I can't help but believe there is bound to be a kernel of truth somewhere. Just one more little yarn, and then I am definitely through. We all know the Chinese had possessed gunpowder thousands of years before Europeans "discovered" it. Did the Chinese invent it? Who knows? But assume, with me, an Atlantean Empire in possession of the secret of explosives. Assume, also, a great war between rivals for the throne. One rival named Chronus (Saturn) is defeated and flees to Italy, where he founds a kingdom and dynasty. His victorious rival slays the ancient Mediterranean shores with his gunpowder, frightening the natives by arriving at night in huge galleys having one gleaming searchlight on their prow.

What is more natural than that the barbarous cave men of Stone Age Europe who, thousands of years later, would become the Greeks and Trojans of our early civilization, would preserve fearsome racial memories of fierce, one-eyed Cyclops devouring them, of a mighty war of Titans and giants and of the victorious king and his gunpowder, the "god" Zeus and his thunderbolts?

Preposterous, you say? Maybe, but no more so than if America was suddenly liquidated and my descendants, five thousand years hence, finally built a machine that would fly through the air like an eagle, because they possessed a myth handed down from father to son from the prehistoric 20th century, of a man, named Charles Augustus Lindbergh, who flew the ocean.—James A. White, Virginia Apartments, 405 East 3rd Street, Wichita, Kansas.

### Science in Science-fiction.

Dear Mr. Tremaine:

When Mr. Duncan checks 'em off, they are really checked off, eh, what? His lively letter will remind me to look up the difference between a positron and a ring nebula, before I write another story dealing with either.

Seriously speaking, I share his admiration for H. P. Lovecraft. But Weinbaum was also a very skilled craftsman, in his somewhat lighter vein. There are moods when one wants to be drenched with preternatural horror, and moods when one wants merely to be amused. And isn't love also an important scientific fact?

May I comment on this question of the science in science-fiction? It isn't, as I see it, the first purpose of science-fiction merely to present scientific fact. There is, of course, a great deal of true science in all real science-fiction—which is a good thing, but more or less incidental.

Stories have been written largely to present facts or to support argumentative theses—but most of them aren't the highest type of literature. The childhood favorite, for example, "The Swiss Family Robinson" is mostly a sort of animated natural history—and rather dry reading after one has become thoroughly familiar with the facts it sets forth.

There is no need for the science-fiction writer to turn out disguised monographs. Such authorities as Eddington, Jeans, Jones, Carrel, Lemmon, and Paul Karlson are constantly writing brilliant popular expositions of the latest research and theory.

But science-fiction, it seems to me, is concerned with something a little different. Its purpose, I think—like that of any art—is to create a unified emotional response to its material. It deals, in other words, not so much with science itself, as with the human reaction to science.

The science-fiction story would bring its reader a vicarious emotional experience, a vital illusion of reality. To cause such a response, it must present various stimuli.

True scientific fact is one necessary element. The writer must be very careful of his accuracy in dealing with known science—because any blunder wrecks the precious illusion. He should keep up with a dozen fields of science.

But speculative theories—daring ideas yet unproven—are also important. So are realistic human characters, harmonious settings, dramatic incidents, and well-fashioned plots.

Modern science has become a tremendously important thing in the world. It's new, strange to a human mind fed for thousands of years on myth and superstition. The business of science-fiction, I fully believe, is to help our modern age make its complete imaginative and esthetic response to science.—Jack Williamson, 235 Harrison Street, Topeka, Kansas.

### Read the Following Letter.

Dear Sir:

In either the February or March issue I read the monthly article upon the solar system by Mr. Campbell. In this particular article he explained the gaseous-tidal hypothesis of the Earth's and solar system's origin. It is the current theory, as advanced by Sir James Jeans and Harold Jeffreys.

I have an objection to a particular part of that article: namely, the statement that the entire formation of the gaseous filament, out of which the nine planets and the planetoids were formed, took but four hours. I do not criticize Mr. Campbell, and am fully open to the conviction that he is correct. However, I do wish to know his authority for that assumption—for it can only be an assumption, just as the whole hypothesis is an assumption.

I have consulted my two textbooks in geology, namely: "Historical Geology," by Schuchert and Dunbar, 3rd edition, John Wiley & Son, Pub.; "Introduction to Physical Geology," by W. J. Miller, Vannoststrand Co., Pub.

I fail to find any reference to the possible time the process could have taken. Also, I have inquired of the various professors of geology at Missouri School of Mines, and none of them have ever read any book which gives a definite length of time for this, and every one of them refused to venture an estimate.

As I previously said, I am open to conviction, so if Mr. Campbell can furnish a reliable refer-

case for his remark, I will concede the point.

However, since I am planning on entering the geology profession, you can naturally understand my curiosity, my doubt, and my readiness for belief.—Risher Hall, 691 West 11th Street, Rolla, Missouri.

### In Answer to Your Questions.

Dear Mr. Tremaine:

In answer to the questions raised by the correspondents in Science Discussions:

Mr. Duncan: Though Moulton does not believe that life exists on the Jovian worlds, neither does he believe that man will ever succeed in leaving Earth to cross space. In both instances I personally disagree with him. Since both are equally controversial, and since neither of us can bring proof to bear, I maintain the right to my belief.

Further, I suspect that Moulton's argument against life confines itself to the low temperature of Jupiter, and to the high-velocity winds. I included the low temperature as a necessary basis for life on a different scheme all together. The terrific cyclones of the extreme upper atmosphere, which is all that is visible to us, probably do not reach to the surface of the planet. The dense atmosphere could not rush by the solid or liquid planet at any such rate; fluid friction would break their force, forming a layer of relatively dead air in the altitudes wherein I propose life may exist.

Mr. Spencer: Planets do cool to the core, it is now believed. In the first few miles of descent into the Earth, temperatures rise rapidly, in fact so rapidly that a continued rise at this rate would indicate an average temperature for the entire planet of something of the order of 50,000° C. Volcanic material and geysers indicate heat beneath the surface, but we cannot assume this to be general. The present belief is that radioactivity accounts for the observed heat of the crustal rocks, and for the volcanic action. Minute as the quantity of radioactive elements in the crust is, it is still too great for general distribution.

Practically all the radio matter on Earth must be in the crust, for if it were distributed throughout the planet in the same concentration, low as it is, the heat released by the disruption of the radium, thorium, uranium, and similar atoms would fuse the planet completely in a comparatively short time, let alone preventing it from becoming solid originally. Local concentrations of not impossibly high degree, taken in consideration of the low heat transmission of rocks, would readily account for volcanic action. Radium is tremendously potent stuff, and a little natural atomic power goes a long, long way.

Mr. Widmer: Telephones continue to function, despite failure of city power. I answer this only because I have a relative connected with that end of the business. Every telephone office is equipped with emergency power sources, generally a series of perfectly gargantuan storage batteries. They come as tall as a man, 5 feet across and 4 feet wide for each cell, with about two dozen cells to a battery. Further, many stations have power plants for emergency use.

Though the Pittsburgh floods cut off city power, and forced the telephone system to conserve their powers by reducing the number of telephones in operation, at no time was service suspended. In one of their stations, a four-hundred-ampere fuse blew several times in rapid succession, due to the sudden increase in calls, and had to be shunted with a buss bar. Within a short time the restriction on the number of operating telephones was lifted, as the united efforts of the Bell companies sent everything from Deico light plants to a Diesel-electric mobile generator unit to tide over.

Mr. Hall: In the article, *Other Eyes Watching*, in the February issue, I stated that the entire process of stellar collision and formation

of the planets took not more than three hours, and at that I was toning down the statement of my authority.

Henry Norris Russell, in his book "The Solar System and Its Origin," states that for stellar bodies of the same order of size, and of about the mass of the Sun, meeting in glancing contact, the time cannot exceed one hour. This time limit is derived from purely astronomical calculations, and is indisputable since it is based on orbital calculations which are perfectly simple and extremely accurate. If the bodies involved were like our Sun, and if they made glancing contact, that so limits the question that the time cannot have been more than an hour. I made it three hours, to take into account the possibility of very close passages not quite making contact.

An extremely close passage is necessary, to allow the strains to become sufficient to tear out the immense masses evidently erupted, and existant now as the planets.

For a complete discussion of the mechanism, I suggest that you read that excellent book, I mentioned above, and Russell's later articles "New Light on the Origin of the Planets" and "More About the New Lyttleton Theory of Planetary Origin," in the October and November numbers of the "Scientific American" for 1936.

Since the problem is so wholly astronomic, rather than geological, the truly astounding picture of the two titanic masses that caused the solar system circling in that catastrophic meeting in less than an hour is not given the prominence its interest warrants.—John W. Campbell, Jr., 413 Central Avenue, Orange, New Jersey.

### Centrifugal Force.

Dear Mr. Tremaine:

Mr. Arnold Anderson, in his letter printed in Science Discussions, in the April issue, is afraid of the "terrific centrifugal force exerted on the cable" connecting the two parts of a space ship as described in *At the Perihelion*. If people would only save big words for big occasions. There is no terrific strain.

The speed of revolution would be selected to produce an acceleration equal to terrestrial gravity, 1 g. This would result in a pull exactly as large as if one of the two parts were suspended from the cable near the surface of the Earth. If we assume that each part weighs 20 tons—which would be approximately right and which would place the center of rotation exactly halfway between the two parts—the strain on the connecting cable would be half of the entire mass of the ship, i.e., 20 tons.

A steel cable able to stand this strain would have to have a diameter of about ¼ inches—which includes a safety factor of sufficient magnitude—and 3 miles of it would weigh about 6,000 kilograms. Actually, these figures would be even lower, since the data used in the calculation are by no means optimal values. Most probably one of the modern, tough aluminum alloys would give even better results, especially at the low temperature to be expected in space.

To produce a centrifugal force equal to 1 g. each part would have to travel about 12 ft. per second. A complete revolution would need 4.335 seconds, or 72 ¼ minutes. If the cable is shorter, the speed of rotation has to increase, the strain on the cable, however, would decrease because it weighs less itself.

I may add that this thought was introduced into scientific literature by Hermann Oberth in Europe and by Noel Delsch in this country.—Robert Willey.

### Parsons' Hypothesis.

Dear Editor:

Until now I have refrained from writing you chiefly because I felt that I had nothing of sufficient importance to write about. But now



I believe I have something which should arouse comment and controversy in the astronomical field. In short, I am offering a hypothesis to answer the question or mystery offered, but not answered, by Mr. Campbell in his article appearing in the March issue on the satellites of the planet Jupiter: "The mystery of the outermost moon of Jupiter (Satellite IX, I believe) which revolves about its primary in an opposite direction and in doing so (according to Mr. Campbell) upsets all the laws and formulae concerning our universe which have been carefully built up by generations of astronomers and mathematicians."

A very sad state of affairs indeed, especially as no satisfactory explanation of why Satellite IX continues to revolve in its opposite direction, like a small boy on roller skates going against traffic, has been advanced. At least, according to Mr. Campbell, none has been advanced. It seems that our astronomers and mathematicians are content to let that little piece of obstinate rock whizzing about Jupiter in the wrong way upset and wreck all their formulae and do nothing about it. But I propose to do something, not because I particularly like astronomers, mathematicians and their ilk, but because I rather like the formulae and the laws of our universe that they have laid down.

No, I don't propose to stop Satellite IX in its mad orbit and send it whizzing around in the other way, just to prove "That God's in his heaven and all's right" with our astronomers and mathematicians, but I do propose a hypothesis which I believe should be acceptable and which is so simple and obvious that I can't believe it hasn't been advocated before. Yet, according to Mr. Campbell, no satisfactory explanation of the silly business of this satellite has been put forward.

And now we come to the hypothesis:

First of all, Satellite IX of Jupiter (the farthest one from Jupiter and the one which revolves about Jupiter in the screwy direction) is not a true daughter of Jupiter, but rather is an adopted daughter. It did not spring from its parent as did our Moon from the Earth or Earth from the Sun (nebula hypothesis, I believe) but is a "captured" body—captured by the gravitational force of its foster parent, Jupiter.

All right, let us admit for argument's sake that Satellite IX of Jupiter is a captured body. Where did it come from? A comet perhaps, or some other object from the depths of stellar space? I say why look so far.

And now we come to the second supposition of my hypotheses (all hypotheses are based on suppositions):

In answer to the question that if Satellite IX is not a true satellite of Jupiter but a captured satellite, where did it come from? I say that it came from the mythical planet No. 5, whose fragments now make up the asteroid belt. According to Bode and many others, the present asteroid belt, which revolves about the Sun in an orbit between Mars, the fourth planet, and Jupiter, the fifth planet (from the Sun), is made up of the fragments of a "fifth planet" which perished in some sort of cataclysmal accident.

My hypothesis is based on the hypothesis that there was a fifth planet whose orbit lay between Mars and Jupiter, that there was a cataclysmal bursting or explosion of said now nonexistent planet, whose remains are now seen in the asteroid belt and Satellite IX of Jupiter. (It is generally accepted that the asteroid belt does consist of fragments of a former planet No. 5.) Granting for the sake of argument that there was a Planet V (not Jupiter) and that it suffered a cataclysmal disruption and that the asteroid belt is a grim reminder of that disruption, where does Satellite IX of Jupiter come in?

And here follows Argument 3 of my hypotheses, which is based on acceptable gravitational laws and not on any other hypothesis: Satellite IX of Jupiter is a fragment of the former Planet V. (While Planet V was still in existence as a planet, it exploded or disrupted at a time when it was closest in its orbit to the planet Jupiter.) Satellite IX of Jupiter, (formerly a part of mythical Planet V) was forced, by the explosion

or disruption, into the gravitational field of Jupiter.

The mythical or now nonexistent Planet V being slightly ahead of Jupiter in its orbit at the time of the disruption forced Satellite IX into the gravitational field of Jupiter, while it (fragment of Planet V or Satellite IX) was being driven by the force of the explosion or disruption in a direction which was contrary to the direction of Jupiter's native satellites. Satellite IX continued its merry anti-astronomical course about Jupiter, thus causing our mathematicians and astronomers considerable headaches. (Please see diagram.)

And there, in brief, is the Parsons' Hypothesis. Whether or not this explanation as to the orbit of Satellite IX will be acceptable to science, I don't know. All I can say is that it is acceptable to me. The hypothesis itself is (to me) so obvious and self-evident that I can't believe it hasn't been advocated before. Perhaps it has. At any rate, I will be interested to hear the pro and cons as to its acceptability or information as to whether it has been advocated before. —Charles Chauncy Parsons, 1936 N. Bronson, Hollywood, California.



### In Appreciation.

Dear Mr. Tremaine:

"Dawn of Flame, and Other Stories," by Stanley G. Weinbaum has been mailed to its subscribers. In behalf of Mrs. Weinbaum, the Milwaukee Fictioneers, Conrad H. Ruppert, printer, and myself, I want to thank your readers for their fine support, which made this book possible. It has been truly a pleasure to publish this memorial to a great writer.

Personally, I want to thank all the fans; Conrad H. Ruppert, for his fine work in printing the volume; George H. Seelman & Sons, for their fine work in binding the book; The Milwaukee Fictioneers, for their assistance; Lawrence A. Keating, for his excellent foreword; Editor Tremaine, for his kind cooperation, and the use of his column for letters; Leo A. Schmidt, who was the inspiration for the volume; Mrs. Weinbaum for her kind cooperation in making manuscripts available; Astounding Stories and Wonder Stories, for reassigning copyrights; Ralph Milne Farley, for legal assistance; Fantasy magazine for publicity; Marvel Tales, for publicity; The British Science-Fiction Association; the ISA; and all the fan magazines, and all those individuals, too numerous to mention, who aided in one way or another. For the information of those who inquired, there are a few copies still remaining unclaimed.—Raymond A. Palmer, 2616 West Michigan Street, Milwaukee, Wisconsin.





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